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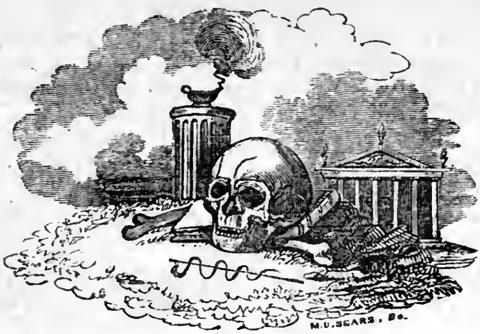

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The American Medical Library and Intelligencer, No. viii. *July* 15, 1837.

*** No. X. *will be published, on the* 1*st April, by* JOHN CHURCHILL, 16, Princes street, Soho; *to whom all Communications for the Editors, and Books for Review, are requested to be forwarded (Carriage paid).*

London: Printed by J. and C. Adlard, Bartholomew Close.

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Th. G. Walle

A

PRACTICAL TREATISE

ON

FRACTURES.

ILLUSTRATED WITH SIXTY WOOD-CUTS.

BY

EDWARD F. LONSDALE,

rancis

SURGEON;

DEMONSTRATOR OF ANATOMY AT THE MIDDLESEX HOSPITAL SCHOOL OF MEDICINE,

AND FORMERLY HOUSE SURGEON TO THE HOSPITAL.

"In prædicendis fracturarum eventibus magnâ utique chirurgis opus est circumspectione."—*Heister.*

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LONDON:

JOHN CHURCHILL, PRINCES STREET, SOHO.

MDCCCXXXVIII.

WALTON AND MITCHELL, PRINTERS, 24, WARDOUR STREET, OXFORD STREET.

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ERRATA.

Page 29, line 18, for "not being," read *rubbing*.
Page 526, line 22, for "superior," read *inferior*.

GENERAL OBSERVATIONS

ON THE

CAUSES, SYMPTOMS, AND TREATMENT OF FRACTURES.

The office which the skeleton has to perform, in supporting and giving attachment to the different soft parts of the body; protecting the viscera, that otherwise would be continually exposed to injury; giving insertion to the many muscles that move the joints and produce locomotion; renders it necessary that the different bones composing it, should be made of a material sufficiently strong to resist ordinary forces, which may be applied to them, either naturally by the muscles inserted into them, or from external violence.

This necessity for making the bones of a hard resisting material, renders them liable to an injury that they otherwise would not be subject to; for the earthy matter which forms so large a component part of their structure, and from which they derive their hardness, gives them at the same time a degree of brittleness, and causes them to be acted on by external forces, and to break either partially or completely, according to the degree and kind of force applied. When a bone is acted upon in this manner by any mechanical violence, which overcomes the resistance it naturally possesses, it is said to be fractured; which term is exclusively applied in surgery to this class of injuries; for although the soft parts are often mecha-

nically separated by external violence, and by one very much resembling that by which a bone is broken, they are still not said to be fractured, but to be lacerated, or torn through, or to be ruptured, which term corresponds, when applied to the soft parts, to the word fracture, when applied to bone. The force, however, acts differently in the two kinds of injury; for when the soft parts are torn through, their fibre generally yields by separation in the direction of their long diameter; whereas in a bone, the fibres give in the opposite direction, the force acting through their transverse diameter.

The fractures of the different bones admit of being divided into many kinds; for, as might be expected, when their shape and structure are found to vary so much, as well as the degree and kind of force that acts upon them, the direction the fracture takes and the extent to which it goes in separating the different portions of bone from one another, are also found to vary. This circumstance renders it important to make distinctions between each kind, and to lay down certain rules by which such distinctions can be easily ascertained, according to the particular bone in which the injury may happen to be; for without a correct diagnosis of the fracture be obtained at first, no principle can be acted upon in the treatment, by which the true apposition of the ends of the bone can be obtained, or by which union can be produced, without, in a great number of cases, deformity existing afterwards, and causing lameness to the patient for the rest of his life.

Fractures are divided into two classes, the *simple* and the *compound;* which are again subdivided into different kinds, according to the extent and the direc-

tion which the fracture takes. The terms simple and compound have reference to the condition of the soft parts round the bone; which, in the former case, are not injured to an extent sufficient to cause a communication between the ends of the bone and the external air. There may, however, be a wound externally in the soft parts, but if it do not lead down to the fractured ends of the bone, it is still a simple fracture. The compound fracture exists when there is such a wound communicating with the bone, either caused by the force acting externally and crushing the soft parts at the time the bone is broken, or else by the ends of the bone themselves being driven through the skin from within outwards, by the force pushing them on after it has produced the fracture.

Fractures are subdivided into *partial*, *complete*, *double*, *comminuted*, external to, or communicating with, the joints. The *partial* fracture exists when a portion only of the bone breaks, the fracture stopping before it extends completely through its substance, so as to leave the fractured portions still continuous in some part with the rest of the bone. In the *complete* fracture all continuity is destroyed, and the portions of bone are separated from one another: in the former kind the shape of the limb is not altered, while in the latter there is generally, though not always, displacement of the fractured ends and a consequent deformity in the shape of the limb. The partial fracture is very rare, the complete very common. The double fracture is also comparatively rare; it exists when the force tells so as to divide the bone into three portions, the central portion being separated from the two extremities. The fracture is said to be comminuted, when the bone is broken into many small

pieces, some of which are often completely separated from the periosteum, and then lose all source of nourishment, and become irritating to the parts around, and require to be removed, either naturally or artificially, before the fracture can unite. The comminuted fracture is generally a serious kind of injury, for it implies that the force has been of a very violent nature to produce it, and is most frequently compound at the same time.

The situation in which the fracture occurs with regard to its being external or communicating with the joint, depends upon many causes. The direction in which the force is applied will have an influence over it; for in many of the long bones, a force telling obliquely through the diameter of the bone, may extend into the joint, although the part struck be not that immediately entering into the formation of it; but the fracture may begin external and extend afterwards so as to include the joint. The position of the limb also favors the direction in which the force tells, and will so have an influence over the joint being injured or not; for example, a person jumps from a height with the limb obliquely under him when he comes to the ground, the force will very likely break the bone in some part of its shaft. Another person jumps from a height and falls with the legs perpendicularly placed, and with the feet flat on the ground; one of two things will then be likely to happen—either the neck of the thigh bone will break, and so cause a fracture into the hip joint, or else, if this part be strong enough to resist the shock, the knee joint may suffer, and the condyles of the femur may split upwards and be separated from the shaft of the bone. The same thing occurs with regard to the ankle and

wrist joints, when a person falls with the tibia or radius perpendicularly placed at the time they receive the shock. It is for this reason that fracture so seldom extends into the joints, compared with those that occur external to them; for the limb is so rarely placed in a position that allows the force to tell upon it so near to the end of the bone, but generally in one that favors it in a direction that causes the shaft to yield; which it does very readily in some bones, when there is length which gives them weakness, and at the same time gives the force a lever power.

The compound fracture is the most serious kind of injury; for not only are the soft parts round the bone often much bruised and torn, which renders an additional and a tedious process necessary for their reparation, but the union of the fractured ends themselves is interfered with, and is found to be delayed for a much longer period than when the fracture is simple. The constitution of the patient also becomes affected, both from the serious nature of the injury, and from the shock produced at the time of the accident to the system generally, as well as from the drain that takes place from the wound, which, except in very slight cases, is slow in healing.

The causes of the compound fracture being of so much more serious a nature than the simple one, depends upon the above circumstances; but the delay in the union, and the interference that appears to take place in the production of the callus, does not admit of so easy an explanation. For although the fact is known from experience, that a simple fracture will become consolidated in three or four weeks, and that a compound one will often take as many months, the

reason of the difference in the process of union is not so apparent. The shock to the system and the consequent diminution of the vital powers generally may be offered as one reason, and no doubt has its influence when it exists to any great extent; for without the patient be in good health, and possess sufficient strength, the process of union of bone may be interfered with, the same as any other function that has to be performed under similar unfavorable circumstances. But it often happens that the compound fracture exists when the shock has been comparatively slight, and the health of the patient is otherwise good, and still the union is longer in taking place than in the simple fracture. The atmospheric air is by some assigned as a cause for this interference in the completion of the process, by coming in contact with the ends of the bone. This may be a cause, but it does not explain how it acts. I believe that two of the principal obstacles that act against a speedy union in the compound fracture, are to be found in the condition of the ends of the bone themselves, and in the presence of the matter that is secreted from the wound, and which gets down to the ends of the bone, and then becomes like a foreign body and prevents the first part of the process commencing; namely, the thickening of the soft parts, which is so essential to form what is called the *provisional* callus. The ends of the bone in the compound fracture lose more completely their attachment to the soft parts adjacent, and to the periosteum which latter is important for their vitality, though it does not take any active part in the first formation of the callus. The presence of the matter however round the ends of the bone, is more important, by

preventing the provisional callus being formed, which it will do so long as it remains in contact with them; for now there are two processes to be gone through, one the reparation of the abscess which exists round the bone; the other the reparation of the bone itself: and it is quite impossible that they should both take place at once, for the one prevents the other, and will continue to do so as long as it exists. This is often seen to be the case in compound fractures, where the opening happens to be in the upper part of the limb, and when the matter has not free exit, the fracture does not unite, but as soon as a counter-opening is made, and the matter is allowed to get freely out, the process of union commences and goes steadily on, the abscess heals up, and the patient gradually recovers.

All the different kinds of fracture may be compound, when the force that produces them acts upon the soft parts at the same time; and it may act in two ways. Thus when a long bone like the femur for instance is broken, and the fracture is compound, it may be caused by the force acting upon the ends of the bone after they are broken, and so driving them through the muscles and skin from within outwards; or else, the force may tell in the opposite direction, and crush the soft parts by acting from without inwards. This is an important point to consider with regard to the compound fracture, for it implies that the injury done to the soft parts will be much less in the one case than in the other, and consequently that the patient will have a much better chance of recovering. For the great difference between the force that produces the fracture causing the injury to the muscles and integuments, and the

ends of the bone being driven through them, is this, that in the one instance, they are not only torn to a great extent (and which extent need bear no relation to the extent of fracture of the bone), but it is of a worse kind, for it acts by bruising and crushing the skin first and then the muscles, when the force acts from without inwards. The consequence of which is, that immense mischief follows; for sloughing and separation of the bruised parts has to take place, which must be accompanied with great draining of the system, as well as ultimately very likely exposing the bone and preventing union altogether; whereas, when the ends of the bone cause the wound, by being driven from within outwards, the injury done to the muscles and skin is not only small in extent, but of the least mischievous kind, for the parts are torn or lacerated, without their vitality being destroyed, as it must be when they are bruised or crushed. There is consequently no sloughing or process of separation to take place before the parts can be repaired, but union is produced at a much earlier period: it is on this account that the compound fracture when produced by the ends of bone, can often be converted into a simple one, by the wound uniting by the first intention, which prevents all the evil consequences that subsequently would arise were it to remain compound. This union of the wound can seldom, if ever, be obtained in the compound fracture, caused by the direct force bruising the soft parts; for their vitality is so much destroyed as to prevent any attempts at union, and if such attempts should be made, the result never bears out the hope that might be entertained of producing it; for sloughing and ulceration take place, and the

union has to be obtained by the tedious process of granulation.

The comminuted compound fracture is always produced by the direct force, and is always a very serious kind of injury. Fracture into joints are more frequently simple than compound, and may be produced either by the direct or indirect force ; when by the former, there is less hope of saving the limb than when by the latter, for the soft parts are generally greatly injured, and often to an extent to require immediate amputation.

All the bones are not equally liable to fracture, for some are not only more exposed to injury than others, but are shaped differently, and are of a form that gives the force, when applied to them, a power that it otherwise would not have. Thus the long bones, though strong enough to perform the offices for which they are intended, and shaped in a manner that gives them advantages in the various movements of the extremities, which they would not possess were they shorter, are at the same time more easily acted upon by external violence ; for this very length, which is so advantageous for the functions of the limb to which it belongs, is disadvantageous when any great force acts upon them; for not only is the bone weaker from its length, but it gives the force a lever power, and yields much oftener than it otherwise would do. It is accordingly found that the long bones are the most frequently fractured, while the cuboid and spongy bones, as they are called, are comparatively seldom broken. Another important practical point derived from observing this difference in the shape of some bones to others is, that the round bones are, with few exceptions, al-

ways broken by the direct force acting on them, while the long bones are as often, if not oftener, broken by the indirect, which accounts for the one kind of injury being always of a more serious nature than the other.

Some of the bones, although apparently of a shape the most favorable for strength and for resisting external violence, are still so situated, with regard to their position in the limb of which they form a part, that the force is enabled to act upon them under circumstances most favorable to overcome their resistance, and to cause them to break. Examples of this are found in the patella, olecranon process, and os calcis. Take any of these bones in their separate state, and they appear to be of a shape the most fitted for resisting forces when applied to them, and to be the least liable to break; yet they are not so when they are articulated with the other bones; for then they are so placed that the muscles can easily act upon them, at the same time that they move upon a fulcrum, and so give the force an increased advantage by causing a kind of lever for it to act upon. This is the case with all of the bones just mentioned, and we find accordingly that they are often broken by the action of the muscles only. The patella is more frequently fractured in this way than by the direct violence. How this injury occurs, I shall explain when speaking of the particular kinds of fracture.

The different offices which the bones have to perform, causes some of them to be fractured more frequently than others, owing to the situation of some exposing them more to injury; thus the bones of the fore arm are more often the seat of fracture than any of the other bones, for the upper extremities are

brought more frequently into use whether it be in the various occupations of life, or to protect the body from external violence, either in the act of falling forward, or to guard against blows with which it may be threatened. The peculiar structure of some of the bones also influences the frequency of their fracture; for the more compact it is, the more brittleness they possess, and so are more liable to break when any violence is applied to them. It is for this reason that the long bones require comparatively a less violent force to act upon them, than the round and spongy bones, which possess but little brittleness, owing to the peculiar manner in which their internal structure is laid out; which instead of being concentrated as it is in the long bones, occupies the whole of their internal surface in the form of cancelli. The spongy bones require a force to act upon them that crushes rather than breaks them; owing to this circumstance, as well as to their peculiar shape, which offers no lever advantage.

The bones are more frequently fractured than dislocated, which is dependant on two causes; one is, that the length of the bone, in many instances, enables a force to tell upon it before it reaches the joint, so that the bone breaks before the ligaments are put upon the stretch. The other is, that although the bones themselves are, from their size and shape, capable of resisting fracture, under ordinary circumstances, the ligaments connecting them together are so much stronger in proportion, that if they are not fractured, the force is not capable of producing dislocation either, owing to the shortness and strength of the ligaments giving them increased power of resistance. An example of this is seen in the bones of tarsus and carpus.

Dislocation is produced more by the peculiar direction in which the force is applied, rather than by any great violence it may possess: thus when the thigh bone is dislocated, it is generally caused by a blow that tells obliquely against the bone, which tends to displace the whole bone, and continues to move it on in one direction until the joint becomes strained, as when the knee or leg is driven forcibly across or behind the opposite limb, the tendency will be to push the head of the bone from the socket, and if the force be sufficient, will do so. Dislocation may also be produced in some of the bones by the force telling vertically upwards, and driving the head of the bone at once from its socket. This direction, at the same time, is the one the least favorable to cause fracture to the bone.

The causes of fracture may be divided into three kinds. 1st. External violence directly applied. 2nd. External violence indirectly applied. 3rd. The action of the muscles inserted into the bone. External violence directly applied to the bone, is the most likely to cause fracture; but this of course depends on its nature and on the power it possesses. The peculiarity of the fracture by the direct violence is, that the bone always breaks at or very near to the point immediately struck; at the same time, that it generally requires an opposing force in the bone itself; gained either by its connection with the other bones, or by a resistance being offered on the opposite side; for were this resistance not offered, the direct force would only tend to move the bone from the position it might happen to be in, and if carried far enough, would produce dislocation, by bringing the strain ultimately upon the joint. Examples of these two

different kinds of resistance may be given as follows. Suppose a person to be standing erect, and to receive a blow upon the outside of the thigh, the bone may be broken before he falls to the ground, owing to the weight of the body above, and the foot resting on the ground below, giving the thigh an opposing force sufficient to enable the blow to tell upon it and to cause its fracture. An example of resistance on the opposite side of the bone is seen where the limb is resting on the ground, or any other hard substance, and a heavy weight of any kind falls upon it. In this case, it is equivalent to two forces acting in opposite directions; for there is the weight itself that comes upon the limb telling one way, while the resistance on the opposite side tells in the other, and so crushes the part between the two. It is on this account, that fractures by the direct force are often of so serious a nature; for it tends at the same time to bruise or crush the soft parts that surround the bone: and this often takes place to so great an extent, as to render amputation of the limb necessary, on this account alone; the fracture, perhaps, being in one part of the bone only, and by itself of no importance. It will be often found, that the destruction of the soft parts bears no relation to the fracture, for they may be lacerated or bruised to an immense extent, and yet the bone may only be broken in one place. The opposite circumstance is seldom met with; namely, a comminuted fracture, with very little destruction of the soft parts around; for this kind of fracture, where the bone is broken in many pieces, necessarily implies that a crushing kind of force has produced it, which must at the same time do great mischief to the muscles and other parts that surround the bone.

The injury done to the soft parts, by the direct force, is not always known at the time of the accident; and this more particularly is the case, where the integuments are not torn: for the immediate perceptible consequence of a bad bruise under these circumstances, is the effusion of a certain quantity of blood beneath the skin, the extent and degree of injury done to the muscles cannot be ascertained. I think, however, as a general rule, in a case of simple fracture of this kind, when there is ecchymosis beneath the integuments, the probability of the degree of injury may be judged of by the extent of ecchymosis present; for where the skin is simply discolored, without the surface or shape of the limb being altered, the injury beneath is but slight, but where such alteration does take place, so as to render the skin tense and smooth, at the same time that the discoloration is very great, the probabilities are that the muscles have been much torn, or else that some large vessel has been wounded. In the compound fracture, the extent of injury can generally be ascertained; for without the wound be very small, the state of the muscles and bone can be examined by passing the finger into the wound. It often happens that they are more bruised than torn, in which case the after effects will decide more than those that are observable immediately at the time of the injury, as to the extent of mischief done.

This great degree of bruising of the soft parts, with the ecchymosis is sufficient in some situations to prevent the fracture being discovered. This is often the case in fractures of the bones of the carpus or tarsus, or of the ends of the bones near to the joints; the swelling around may be so great, as to prevent either

motion or crepitus being discovered, which at all times is more difficult to ascertain when the fracture is situated in these parts, than when in the larger bones, or further from the joints.

The evil effects that arise from the direct force being applied very violently, are sometimes sufficient to destroy the life of the patient, by producing so great a shock upon the system generally, that he never recovers from it. It also happens, that although the patient may recover from the immediate effects of the shock, that he has not strength to bear up against the consequences that are always to be expected after an extensive injury of the muscles and integuments; namely, great sloughing and suppuration which must take place before the parts will heal; during which tedious process the patient may either die from the active fever that sets up, or he may ultimately sink from the drain upon the system generally, and die from exhaustion and low fever. This latter termination is met with most frequently in old people; the former, in those that are young.

The indirect force acts by breaking the bone at a point remote from the part struck; as when a person falls with the arm or leg placed obliquely beneath him, the extremity of the bone may receive the shock and come in contact with the ground, but the shaft will be the part that yields and breaks at or near its centre. The great difference then between this kind of force acting and the direct, is, that the indirect is little liable to do much injury to the soft parts, except in the immediate neighbourhood of the ends of the bone; at the same time that it seldom breaks the bone in more than one place. It does sometimes happen, however, that the ends of the bone are pushed through

the muscles and integuments, by the force continuing on after it has caused the fracture, but then this is comparatively trifling to those cases where the direct force produces the compound fracture; for now not only are the soft parts round the ends of the bone injured, but those far distant from them may be, and the injury is of a much worse nature, for they are bruised as well; whereas by the indirect force they are torn and lacerated. Another difference between the direct and the indirect force, is, that while the former can act on any bone, if applied with sufficient violence, the latter can only act on particular bones, such as from their length give the force a lever power, and enable it to snap the bone across, as is the case with the long bones. The indirect force cannot act upon the round or spongy bones; their fracture, as already stated, is caused by the direct.

Fractures produced by the indirect force, are much more frequently simple than compound; and this can easily be understood, when it is considered that there is no resistance required on the opposite side of the limb, at the same time that the force is destroyed by the bone breaking and checking it. It does sometimes happen, however, that the fractured ends are driven onwards, as when a person jumps from a height and fractures the femur or the tibia; the weight of the body may then be sufficient to force the ends of the bone through the muscles and integuments, and cause the fracture to be compound. The absence of this bruising of the soft parts, and the fracture being generally in one place only, renders the injury of a much less serious nature than when the direct force acts, and is attended with the evils already mentioned.

The third kind of force which sometimes acts upon

the bones and produces their fracture, is the muscles; and they may act in two ways,—thus, where the bone is so placed as to be favorably situated for them to act upon it, as is the case with the patella or os calcis, which bones not only have powerful muscles attached to them, but are placed upon a fulcrum, and so give a lever power to the force when the muscles act. It is found, on this account, that the patella is more frequently fractured in this way, than by the direct force being applied to it; fracture of the os calcis in this manner is a rare accident. The other way in which the bones are broken by the action of the muscles, is dependant on the structure of the bone being weaker than natural, owing to some diseased action being present. In these cases the muscles often snap the bone across in lifting heavy weights, or turning suddenly in bed, or by producing any great strain upon the bone which tells transversely across it.

The above causes may be reckoned as the active or immediate ones of fracture, for they act mechanically on the bones themselves, and if with sufficient power, will always break them, and cause that kind of fracture which is peculiar to the situation and direction in which the force was applied. There are, however, other causes, which may be called the passive or predisposing ones, for they take no part in producing the mechanical violence, or in directing the force that fractures the bone; but merely from circumstances peculiar to the bones themselves, enable the force to act more easily upon them, and in a manner that otherwise it would not be disposed to do.

The causes that predispose the bones to fracture, may be divided into two kinds; namely, those that influence the frequency and liability of the bone to

fracture, its structure being healthy; and those which influence it, the bone being diseased; by which its power of resistance is impaired, and a force enabled to act upon it much sooner, and under circumstances that it otherwise would not be enabled to do. The circumstances that influence the frequency of the fracture, are found in the situation and position of the bone; thus some bones are placed so as to be often exposed to injury, when a person falls, and will therefore be more frequently fractured than those that are not so situated. It is for this reason that the bones of the fore arm, the clavicle, and ribs, are more frequently broken than any other bones in the body. The shape of the bone also influences the frequency of its fracture, for a long bone is oftener fractured than one of the flat or round bones, owing to the force acting more easily upon it.

In order to shew the comparative frequency of the fractures of the different bones of the body, I have drawn up a table, illustrating the number of each kind of fracture admitted as in and out-patients at the Middlesex Hospital, for the space of six years, from September, 1831, to September, 1837.

TABLE OF THE COMPARATIVE FREQUENCY OF FRACTURES IN THE DIFFERENT BONES.

		Out-Patients.	In-Patients.	Total.	
HAND	Phalanges	63	3	66	
	Metacarpus	50	—	50	
FORE ARM	Both bones	85	8	93	386
	Radius, singly	193	4	197	
	Ulna, singly	63	1	64	
	Olecranon	29	1	30	
	Coronoid process	2	—	2	
HUMERUS	Shaft	78	11	89	118
	Neck	13	—	13	
	Condyles	16	—	16	

		Out-Patients.	In-Patients.	Total.	
Clavicle	. . . .	. . 260	. . 13	. . 273	
Scapula .	Body of the bone	. . 3	. . 5	. . 8	
	Acromion process	. . 8	. . —	. . 8	
	Neck of the bone	. . 2	. . —	. . 2	
Face . . .	Ossa Nasi . . .	. . 10	. . 3	. . 13	
	Upper jaw . . .	. . 1	. . —	. . 1	
	Lower jaw . . .	. . 9	. . 23	. . 32	
Thorax .	Ribs	. . 270	. . 87	. . 357	
	Sternum	. . —	. . 2	. . 2	
Pelvis . .	. . . .	. . —	. . 7	. . 7	
Thigh . .	Adults	. . —	. 144	. . 144	
	Infants	. . 37	. . —	. . 37	
Patella .	. . . .	. . —	. . 38	. . 38	
Leg	Both bones . . .	. . —	. 197	. . 197	289
	Tibia	. . —	. . 41	. . 41	
	Fibula	. . —	. . 51	. . 51	
Foot* . . .	Os Calcis	. . —	. . 2	. . 2	
	Astragalus . . .	. . —	. . 1	. . 1	
	Toes	. . 4	. . 7	. . 11	
Skull . .	. . . .	. . —	. . 48	. . 48	
Spine . . .	. . . .	. . —	. . 8	. . 8	
	Total number, during six years . . .			1901	

It will be seen from the above table, as might be expected, that those bones are most frequently fractured, that are from their situation, the most exposed to injury; at the same time that their shape is one that enables a force to act upon them more easily than upon other bones, that are less frequently fractured.

* Fractures of the small bones of the tarsus and carpus are not inserted as distinct fractures in the hospital books, but come under the head of severe lacerations, or bruises, the injury of the soft parts being the most important point; I have, however, seen many cases.

The bones of the fore arm are found to be oftener fractured than any other bones; next to them, the ribs, and then the clavicle, and after this the bones of the leg.

The second predisposing cause to fracture is found in the structure of the bone, which is liable to become diseased and to be chemically altered, so as to render it incapable of offering that resistance, which it does in its natural and healthy state. There are certain diseases in which the component parts of the bone become changed either chemically or by having their relation to one another altered, so that one part, either the animal or earthy, may become predominant, and cause it to yield from comparatively slight causes. Examples of these diseased conditions of the bones are to be found in those affected with cancer, scrofula, and the venereal disease; in this latter, however, the bone is often directly absorbed in parts, and becomes weakened on this account. In the former diseases, the size of the bone remains the same, and yet its structure is more fragile. In old people as well as in young, the bones may become chemically altered; in the former, the earthy matter predominates over the animal, which gives them brittleness, and consequently causes their fracture to take place much more frequently than would be the case were the animal matter in larger quantities. In young people, the disproportion in the component parts is reversed; for in them the animal matter predominates, as in the disease called rickets, when the bones bend under the weight of the body, or under the action of the muscles. This circumstance, however, I believe often saves the bone from fracture, for at the same time that they are weaker, they are less brittle; and so will often yield by bending to a certain extent, and not be so easily affected

by shocks. It is surprising how in some cases of rickets there appears to be a predisposition to fracture in the bones. I remember seeing a case of a girl, in whom there had been twenty-two fractures, most of the bones were rickety, and united in the usual time; but were subject to fracture from the most trivial causes. In old age, two reasons combine to cause the frequency of fracture; the one is the infirmity that generally accompanies it, rendering old people more liable to falls, at the same time that they fall with more weight, the limbs having lost the elasticity they possess in youth; the bones also possess more brittleness, from the smaller portion of animal matter contained in them.

The peculiarity of cancerous and scrofulous bones, is, that they fracture by very slight causes. Cases are on record of persons fracturing their thighs by simply turning in bed, or their arms by lifting substances of little weight. I remember seeing a case myself of a woman who fractured the humerus, by trying to reach something from a shelf that was some little distance above her head.

Another predisposing cause to fracture I think may be mentioned; I mean where there is an inordinate power in the muscles: yet I am aware that this circumstance is almost always accompanied with an increased degree of strength in the bone itself. But still I think that in some, the muscles are too strong; and that fractures are often produced in persons possessing this increased power, when in weaker they would not be. Fractures of the patella and os calcis are caused by this increased muscular power, and of the humerus sometimes; two cases of which I shall have presently to mention. The reason why fracture

of the patella never takes place in very young people, is owing to the circumstance of the absence of the muscular power sufficient to break the bone. The increased power of the muscles when the bone is healthy, is equivalent to the muscular power being natural, and acting upon a bone that is diseased; for in both cases the bone is too weak to resist the force applied.

SYMPTOMS OF FRACTURE.

The symptoms of fracture are the signs which are made evident, either from the appearances the part in which the fracture exists presents to the eye, with regard to the shape or position of the limb; or from certain sensations that are communicated to the hand, when the limb or part is examined, which indicate that a solution of continuity must be present in a part of the bone where naturally none ought to exist.

The symptoms that are evident to the eye, are fewer than those that are discernible by the hand. All that the eye can discover in looking at a fractured limb, is the unnatural shape of it produced by the displaced portions of bone; at the same time that their position will be altered, and the limb will be shorter than natural if the contact of the ends of the bone be destroyed. The symptoms that are evident to the hand, are more numerous. Thus there is riding of the ends of the bone upon one another, causing a prominence to be felt in the direction in which they are displaced; motion of the fractured portions; grating of the fractured surfaces upon one another, producing what is called the *crepitus;* the direction of the fracture if it can be discovered; its kind, with regard to its being single, or double, or comminuted, or ex-

tending into or being external to the joint; also the exact situation of it; which is most important to decide, with regard to the different muscles that will pull upon the fractured portions, and which will indicate the position the limb should be placed in during their reduction, and the treatment that has to be adopted afterwards.

Besides the above symptoms, there are others which are often present, such as severe pain and swelling of the limb, violent spasm of the muscles, inability to bear any weight upon the bone, or to move it. There are also other attendants on a fracture, which however must rather be called accidental than constant symptoms, such as wounds of the arteries and veins, and laceration of the muscles.

I shall describe these various symptoms separately, and consider the peculiarities of each; pointing out at the same time the difficulties that often occur owing to some one or other of them being less marked than usual, and so obscuring the diagnosis; for it must not be expected that all those symptoms will be present, that are enumerated as possible to occur; for circumstances arise, in almost every case of fracture, to render it difficult to discover every particular symptom that might be looked for, did all fractures occur from the same causes, and take the same direction.

The first thing to be done, when called to a patient who is supposed to have a fracture, is to learn the nature of the accident; and this should be done before any examination of the limb is commenced; for in the majority of cases, the history of the accident will enable the surgeon to know what to expect to find, and so will guide his examination with more certainty, and with more likelihood of finding out the true nature

of the injury, than if he were to begin indiscriminately to examine the limb, without knowing what he was likely to find, or what from the nature of the accident it was impossible he could find: the consequence of which would be, that he would put the patient to a great deal of unnecessary pain by prolonging the examination, and being obliged to repeat it before he could be satisfied. There is a systematic way of discovering a fracture, which consists in having certain objects in view, the explanation of which will indicate the situation and direction of the fracture, and the position of the ends of the bone. First, ascertain the kind of force that struck the part, whether it was a blow or from a fall; what the nature of the substance was that struck the limb, and in what direction it was applied. If the person fell, ascertain, as near as possible, the position of the limb when he came to the ground: and this point is a most important one to know, as it will tell whether the fracture was caused by the direct or indirect force. This of course can only be ascertained when the person himself is competent to describe it, or when there have been bystanders who happened to see the accident. It often happens, however, that the patient is by himself at the time, and that he has received some injury of the brain, or that he was intoxicated; in these cases, of course the above information cannot be gained. Under these circumstances the limb must be at once examined, without knowing what the particular kind of injury is that is likely to be met with; endeavours must be made to find out rather if there be any fracture at all, and the symptoms taken as they arise.

Displacement of the ends of the bone is the first symptom to be expected after a fracture; for as soon as

a solution of continuity exists, the shape of the limb is liable to become altered, and a corresponding deformity is then produced, according to the direction in which the ends of the bone are displaced. Deformity of the limb then is one symptom of fracture, and will generally be found to correspond with the position of the fractured ends of the bone. Fracture, however, may occur, and often does, without producing any displacement of the portions of the bone, and consequently without causing any deformity in the shape of the limb.

The causes of displacement of the fractured portions, are two; namely, the force that produces the fracture, and the action of muscles upon the bone afterwards. The force that produces the fracture must always have a tendency to displace the ends of the bone, by telling upon them in the direction in which it was applied, and so driving or pushing one beyond the other; and this is the cause of the compound fracture being produced by the ends of the bone themselves, as when they are pushed through the muscles and skin from within outwards. The indirect force tends more to produce displacement than the direct; for the former tells in the long diameter of the bone; the latter in the transverse, and generally has an opposing force to check it. But there are many cases where the indirect force acts, and simply snaps the bone across, without telling afterwards with any great violence, and consequently without producing any great displacement.

The force acts upon the fractured portions of bone in some cases easier than in others; for it will be found that the situation of the fracture, and the direction it takes, will greatly influence its power of

producing displacement. In fractures near to joints, the ends of the bone are seldom acted upon in the same manner by the force that causes the fracture, as they are when the injury is to the shaft of the bone: and there are two reasons for this; the one is, that the surfaces of the bone are broader, and less easily moved upon one another, owing to the fracture being rougher and more irregular; the other is, that the force loses the lever power on the lower portion of bone, which it has in fractures near to the shaft, so that the ends of the bone are less likely to be unlocked. The direction the fracture takes influences the degree of displacement; for when it is very oblique, the least force will be capable of pushing one portion beyond the other, while, if it be transverse, it will require a much more powerful one to do so.

The action of the muscles is often a very great cause of displacing the fractured portions of the bone; and this is to be expected, when the bone is looked at in its sound state, and when the many powerful muscles that surround some of them are considered: for what is called the tone of the muscles is always tending to cause shortening of the muscular fibre, and consequently will have more tendency to do so when the bone is broken, and the resistance removed which was opposed to it, while the continuity of the bone was perfect: and this shortening cannot take place without producing a corresponding displacement of the one portion of bone beyond the other. But not only is this natural tonic contraction allowed to act more freely when the bone is broken, but very often a more powerful action is produced, namely, spasm of the muscle, which differs from the tone by being more sudden and violent, and resisting all attempts that are

made to overcome it; whereas the tonic contraction can generally be overcome by gentle and continued extension against it.

It very often happens that the muscles have contracted gently and quietly, as soon as the bone was broken, and remain so until extension is made upon them, when they suddenly start into spasm, and in many cases prevent the reduction of the fracture altogether; while in other cases this spasm exists from the first, and remains so for many hours after the fracture, without any extension at all being made, and without the limb being disturbed.

The muscles may produce displacement by drawing one portion of bone above the other, and causing them to ride; or else they may simply alter the angle of the limb, by drawing the lower portion into a different line, the fractured ends still remaining in contact. They cannot produce shortening of the limb without the fractured ends be out of apposition; and this loss of apposition may be produced in two ways, either by the force that caused the fracture driving the one portion from the other, or else the direction of the fracture may be so oblique that the ends of the bone slide easily from their contact, and are then displaced by a very slight action of the muscles. This displacement of the one portion beyond the other is called the "riding" of the fractured ends, and gives another indication, when present, of the nature of the injury.

The symptoms then produced by the displacement of the fractured portions of bone are many. 1st. The shape of the limb will become altered, being shorter and broader than natural; the diminished length, and increased breadth, corresponding to the degree of the

displacement and the direction in which it takes place. 2nd. The angle of the limb may be simply altered, owing to the fractured ends being still in contact, though their line of apposition is not the same. 3rd. When the riding of the ends of the bone is felt, the projecting portion will indicate the situation of the fracture, as well as the position the ends of the bone may happen to be in. Of course all these symptoms will be increased or diminished, according to the degree of force that has been applied to produce the fracture, and the subsequent extent of displacement. They are all of them more prominent when the fracture is very oblique, and when near to the centre of the long bones.

The next symptom to be looked for in a fractured bone, is the motion of one portion upon the other, causing the limb to bend at some part, where naturally no flexion ought to exist; indicating, at once, a solution of continuity in the bone. Motion of the fractured portions, however, must not be looked for as a constant symptom; for it exists under certain circumstances only, and in a very great number of cases is absent altogether. The power of producing the motion of one portion of bone upon the other, depends on the situation of the fracture, and on the bone that it happens to be in. In fractures through the long bones, such as the femur, humerus, radius, ulna, &c., the portions of bone can be easily moved upon one another; but in these cases a great deal depends on the situation of the fracture; for although motion can be produced when it is in the shaft of the bone, it is often difficult to do so when the fracture is near to the joints; and the reason of this is, that in fractures near to joints the surfaces of the bone are broader and rougher, and are more easily locked against one another, and conse-

quently less easily displaced. Another reason is that the fracture near to a joint, necessarily makes the portion of bone that is connected with the joint itself so small, that it is with difficulty grasped with sufficient firmness to enable it to be fixed, while attempts are made to move the upper or longer portion upon it; besides, the joint itself will weaken the hold upon the bone, as it has to be grasped at the same time.

When motion can be got of the two portions of bone, the nature of the injury can be easily ascertained; sometimes however, as already stated, it is so slight, and so difficultly produced, that doubt may exist, as to whether the one portion really does move upon the other. In these cases, it is necessary to try and produce another symptom, which will materially assist in forming the diagnosis; namely, the *crepitus*, a grating sensation which is produced by the fractured surfaces not being against one another. The crepitus, however, is a symptom altogether dependant on the previous one just mentioned; for without motion can be got to a certain extent between the two fractured surfaces, it cannot be produced; so that as a general rule, the freer the motion between the portions of bone, the more easily the crepitus is produced. Still, however, the crepitus may be produced (and these are the cases in which it is useful,) where the motion between the fractured portions of bone is so small, as to be of no use as a symptom by itself; for doubt may exist as to whether they really do move, or not. But notwithstanding this, there may be sufficient motion to cause the one surface to grate upon the other; and if it be ever so small, it may cause that peculiar sensation called the crepitus, which at once indicates fracture to exist. The crepitus is useful when the fracture is

near to the joints, and when the two portions do not move freely upon one another; it is also useful where the limb is greatly swollen, or when the fracture is situated in a bone, that from its position does not allow of the fractured portions being firmly grasped. In all these cases, crepitus can often be produced, although no sensible motion between the fractured portions themselves can be obtained.

Motion of the fractured portions of bone does not necessarily produce a crepitus; for the ends of the bone may be so much displaced, that their fractured surfaces are out of apposition, and any motion that is then given to them, will cause no grating sensation, but merely move the one portion by the side of the other; the rough surfaces being out of contact. This is a point to be remembered, in examining cases where the fracture is near to some of the joints, as the hip for instance; for it often happens in fractures through the neck of the thigh bone, that free motion can be produced, and yet no crepitus is got, owing to the one portion of bone being drawn up beyond the other, and so destroying the contact of the fractured surfaces. In these cases the limb must be extended, and the portions of bone brought opposite to one another, when crepitus can easily be produced by rotating the lower upon the upper.

There is another case, where the motion of the fractured portions of bone does not produce the crepitus. When the fracture takes such a direction that it allows of a hinge kind of motion, though no rotation of the one portion upon the other can be produced. The angle of the limb may be altered in these cases, and indicate sufficiently that the bone is broken by the free motion allowed, and yet no crepitus may be present.

The peculiar sensation which the crepitus gives, cannot be mistaken after it has once been felt. There are however, some circumstances, under which the presence of fluid, would lead those into error who were not prepared to meet with it, or who were little accustomed to examine fractures. Injuries near to joints are often attended with effusion of fluid into the sheaths of the tendons and between the ligaments, and when this fluid is pressed upon with any violence, as it must be during the examination of the part, in order to ascertain if fracture exist or not, it is very liable to produce a sensation, which might be mistaken for the crepitus of a fracture, by one inexperienced in examining these kind of injuries. I should describe the sensation produced by the pressure of the effused fluid as a kind of *creaking*, while that of the fractured surfaces is a distinct *grating*. The difference, however, is much easier to understand, when it has once been felt, than to be described by words. This point should always be borne in mind, in forming a diagnosis of injuries near to joints. The great distinction between the crepitus of fracture, and the sensation produced by the effusion of fluid is, that in fracture the crepitus can be felt throughout the whole limb, being communicated by vibration; so that it can be often discovered in examining fractures of the neck of the thigh bone, by taking hold of the patient's foot, the sensation being passed downwards through the different bones; whereas when fluid is effused round the joint, it can generally only be felt by making pressure immediately on the part itself; and simple pressure alone is often sufficient, without moving the limb at all.

The direction the fracture takes influences the pro-

duction of the crepitus; for, as already stated, the ends of the bone may be locked within one another, and still allow of motion angularly, though they cannot be displaced sufficiently to allow of rotatory motion, or of their moving laterally upon one another. On the other hand, the direction of the fracture may be such, that the slightest motion is sufficient to move the fractured surfaces upon one another, and to produce the crepitus. The crepitus is a most useful symptom, when the diagnosis is difficult to form, owing to the absence of deformity in the shape of the limb, or when the motion of the fractured portions is obscure, it always confirms the nature of the injury, though in the majority of cases the fracture is sufficiently evident without it.

Displacement of the fractured ends of the bone, motion of the portions of bone, and the production of the crepitus, are the three most prominent and only decisive symptoms that fracture does exist. There are, however, other symptoms which may be mentioned as concomitants, though abstractedly, without the existence of the previous ones just mentioned, they are of no use: these are pain, inability to use the limb, and injury of the soft parts round the bone.

The pain that is present in a fractured limb is often very slight, while at other times it is most acute, and the patient cannot bear the least examination of the part to be made. In this latter case, the surgeon should be very particular in his first examination, and endeavour to gain all the information that he can of the nature of the injury; as he will then save his patient an immense deal of suffering by not requiring to repeat it, or to disturb the limb a second time. It is difficult to give a decided cause for the different

degrees of pain, that different patients suffer; some are met with who do not know that their bones are broken, and they bear the examination of the limb without any apparent suffering; while others, on the slightest motion of the part, express pain in the most acute degree. The injury of the soft parts we should expect to be the immediate cause of the pain; but this is not borne out by experience in all cases, for it not unfrequently happens that fractures are attended with great bruising and injury to the soft parts, and where the patient's sufferings are comparatively trifling. While there are other cases where the injury done is but slight, and yet the sufferings of the patient are very severe. The after-pain which arises with the inflammation is easily explained from analogy in other parts, where we find increased sensibility is almost always an attendant upon the inflammatory action that takes place in the textures so affected. But this varies greatly in degree, for some patients pass through the whole period of the process of union, without experiencing the least pain; while others suffer throughout the whole time and never seem to be free from it. The temperament of different people varies so much, that I believe upon it depends this different degree of suffering that is met with, though it is difficult to say how it acts.

The only practical use derived from taking the pain as a symptom in the limb supposed to be fractured is, that it may indicate the precise spot where the fracture exists, and so will enable the surgeon to make his examination with more certainty of finding out the situation of the injury, than he otherwise might do, having no such symptom to guide him. In fractures near to joints the pain is generally greater, than

in fractures elsewhere, owing, I believe, to the joint itself being strained at the same time, and causing the pain of the injured ligaments to be combined with that of the fracture.

The inability to use the limb may be dependant on two causes; the one is the total loss of all fixed points for the muscles to act upon, as when the bone is separated into two or more pieces; the other is that the muscles themselves may be so much bruised, as to lose all power of acting, being as it were paralysed. The patient, however, often possesses the power of moving the limb, though he does not do so; for the pain causes him to desist as soon as he makes the attempt. This symptom, like the former one, is only confirmatory of the nature of the injury, when taken in conjunction with others, but by itself decides nothing; for the simple absence of motion in the limb may exist with a bruise only, quite independent of any fracture being present. This point should be borne in mind in examining cases where the nature of the injury is obscure. There are many cases of fracture, however, where the patient can use the limb, and bear his weight upon it, if it be the lower extremity that is injured; these are, however, the exceptions and not the general rule. In fractures of the neck of the thigh bone, the patient can sometimes walk a short distance after the receipt of the injury. In these cases no doubt the fractured surfaces are locked together, either owing to the peculiar direction the fracture has taken, or else to the capsular ligament not being torn, which may be sufficiently strong to keep the fractured ends in contact. In fractures of a part of the limb, where there are two bones, such as the leg or fore arm, the patient is often enabled to walk and use the limb

where one bone only is broken; and this is easily explained, as the sound bone then supports the weight, and gives a fixed point for the muscles to act upon. In the majority of these cases, however, the limb is rendered useless, either from the weakness produced in it, or from the pain the patient experiences on the least attempt to move it.

The last point to be observed as a symptom of fracture, is the injury done to the soft parts round the bone. It is, however, more properly speaking, only one of the effects produced by it, and leads to no indication either as to the situation or direction it may have taken.

The extent and degree of bruising of the soft parts depend on the kind of force applied to produce the fracture; for when the direct force acts, the soft parts are crushed or bruised to an extent which may be great or small, according to the violence with which it acts and the mode of its production. When it is caused by the indirect, the injury done is inflicted by the ends of the bone themselves being driven from within outwards, and is much less serious in its after consequences than when the former kind of force acts; for in the one instance the soft parts are crushed, and their vitality more or less destroyed; while, in the other, they are only lacerated or torn through, and comparatively little injury done to their internal structure. It is this circumstance that renders the compound fracture so much more serious, when produced by the direct than by the indirect force; for the former causes sloughing and inflammation to take place, whereas the latter causes no such evils, but sometimes produces such little mischief, that the injury can be at once converted into a simple fracture, by bringing the

edges of the wound together, and causing union by the first intention. The direct force acting, frequently requires amputation to be performed; the indirect, seldom.

In some cases the artery in the immediate neighbourhood of the bone is wounded by the ends of the bone puncturing it, or tearing it across. The ecchymosis that then attends the fracture may be very great, and becomes a source of great mischief, both to the parts in which the blood is effused, as well as interfering with the process of union of the fractured ends. When the artery is torn through by the direct force acting, it is seldom owing to the ends of the bone, but to the force itself, which at the same time that it crushes the soft parts, also tears through the artery. In these cases it most frequently becomes necessary to amputate the limb, owing both to the wound of the artery, as well as to the mischief done to the muscles and integuments. Where the artery is wounded by the ends of the bone coming in contact with it, the vessel itself may be the only important part injured; for under these circumstances it is generally the indirect force that acts to produce the fracture; and very often causes little or no mischief to the surrounding soft parts. The arteries most frequently torn through in fractures are those of the leg, for these vessels are tightly bound down by the fascia, and offer more resistance for the ends of the bone to act upon, than in other situations; at the same time that the fracture itself takes a more oblique direction through the tibia than in other bones, and so presents a sharp edge, and one more likely to wound the vessel.

It becomes a question in these cases, how far the

wounded artery will influence the recovery of the limb, both as to the vitality of it, as well as with regard to the production of the union of the fractured ends. Some are of opinion that when the wound of a large artery is present with a fracture, the limb should be removed; this opinion, I believe, is not held so much in the present day as it was formerly, nor do I think it ought to have much importance, when the soft parts otherwise are not much injured: for we know from observation, that the simple wound of an artery does not render amputation necessary, but that the anastomotic branches soon become enlarged, and allow of the circulation of the limb being soon re-established. The fracture of a bone then being present cannot make so much difference, if the soft parts otherwise are not injured sufficiently to render the removal of the limb necessary; at the same time I believe that it will generally be found that these cases are always very serious, from the great mischief that most frequently does accompany the wound of an artery attendant upon a fracture, and more particularly when the injury is produced by the direct force.

Spasm of the muscles of the fractured limb is often an attendant symptom, though not a necessary one. It will be considered, when speaking of the reduction of fractures.

GENERAL REMARKS ON THE TREATMENT OF FRACTURES.

There are certain principles which are applicable to the treatment of all kinds of fracture, which admit of being generalized, and which require consideration in whatever bone the fracture happens to be situated; on the other hand, there are a great many points which are peculiar to each particular kind of fracture,

and which require to be considered under separate heads. The bones in the different regions of the body are so differently circumstanced, both from their position, as well as from their shape, and from the variety of muscles that act upon them; that different treatments are necessary for each particular bone, and for different kinds of fracture in the same bone.

The treatment of a fracture consists essentially, in redressing any displacement of the portions of bone that may have taken place, and in keeping them at rest when they have once been brought into proper apposition, until firm union has taken place, sufficient to allow the patient to use the limb again. It admits of being considered under two heads; namely, the reduction of the bone, and the confinement of the fractured portions, by employing those means that best preserve their apposition. Under both these heads, a great many points have to be considered.

The first point to be looked to in reducing a fractured bone, is the position in which the ends of the bone are displaced, and the muscles that act upon them; and which, from their situation, will be likely to be brought into a state of spasm when pulled upon. It often happens that the portions of bone are riding to a great extent upon one another, and that the least attempt at reducing them puts the muscles into the most violent action; which, in many instances, cannot be overcome, and prevents the reduction altogether. In these cases the points to be considered are, the side of the bone on which the displacement exists; the direction the fracture has taken; and the action of the different muscles attached to the portions of bone, and which are disposed to pull them in the direction of the displacement. The position of the displaced portion of

bone can generally be ascertained, if the patient be seen at an early period after the fracture, and if no great swelling be present: for by making pressure on the two opposite surfaces of the part injured, at the same time that the natural line of the bone is carried in the mind, by looking at the two joints at either extremity of the fractured bone, and observing their relative position to one another; and then feeling for the prominence on one side of the limb, and a corresponding depression on the other, the position of the ends of the bone will be easily discovered. The position and shape of the limb by themselves are often sufficient to indicate the direction of the displacement, without any manual examination being necessary. The particular direction the fracture may have taken is not always easy to ascertain; for without the bone fractured be situated very superficially, or without the end of the bone be displaced to a great extent, the fractured surfaces cannot be felt with sufficient distinctness to indicate whether it be oblique or transverse, or in what direction it may have extended. In a bone like the tibia or ulna, for instance, the line of fracture may be ascertained, but in the femur or radius, which are so thickly covered with muscles, it is very difficult to do so, without the ends of the bone be thrust forwards so as to bring them near to the surface of the limb. The object of endeavouring to ascertain the precise position of the ends of the bone, and the direction of the fracture is, that it will, as a general rule, indicate the line in which the force is to be applied in reducing the bone. Thus if the thigh, for instance, be fractured, and the portion of bone be displaced upwards and inwards, the force must be applied downwards and outwards, being the line that it is most likely to

replace the fractured ends in their natural position. Another important point gained by a knowledge of the direction and exact situation of the fracture is, that it will indicate the position that is most likely to keep the ends of the bone in apposition, and to relax the muscles that are disposed to produce displacement.

The many different muscles attached to the bone have to be well considered, for upon their action or relaxation, depends the power or inability to bring the portions of bone into apposition. It should be remembered, that all muscles that act upon bones, are attached by one of their extremities to the bone that forms the joint immediately beyond it, otherwise no motion could of course be produced. There are also some muscles which move particular bones, without being attached at all to the bone itself, but pass from joint to joint, and move the intermediate bone, by acting on the two that are placed at either extremity of it. Many examples of this are seen in the lower and upper extremity: thus the sartorius, rectus, gracilis, semimembranosus, semitendinosus, &c.; all have the power of moving the thigh bone, yet none of them are inserted into it, but act upon it by moving the hip and knee joints, the muscles themselves being attached to the pelvis and tibia. Examples of the same kind are seen in the arm and fore arm.

The important practical inference drawn from considering the above points, is, that the only way to relax the different muscles that are disposed to act upon the fractured portions of bone, is to place the limb in that position which brings the origin and insertion of the muscles as near as possible together; which is to be done by flexing some of those joints that are connected with the fracture, while others are ex-

tended;—the flexion, or extension, and the degree of it to be employed, being indicated by the position of the fracture and the disposition to spasm in the muscles. Without the surgeon then be perfectly acquainted with the relative position and attachment of the different muscles that are connected with the particular bone fractured, he will not be able to conduct his treatment on any scientific principle; and in difficult cases will be prevented altogether from reducing the ends of the bone to their natural position—from ignorance of that posture of the limb which relaxes the muscles at once, and which would enable him to bring the ends of the bone into their place with ease.

Having considered then the direction of the fracture, and the situation of the ends of the bone, and the various muscles that will have the power of producing displacement; that position has to be adopted which allows of their reduction with the most ease, and which will keep them best in apposition when they have been so reduced. Two forces are necessary to reduce a fracture; one, that fixes the upper portion of bone, which is called the counter-extension; and one, which pulls upon the lower portion, which is called the extension. The counter-extension consists in steadying the upper portion of bone, by means of bandages passed round the nearest joint; or else (as is most frequently all that is necessary) in simply fixing the body of the patient, or the upper portion of the fractured limb; which its own weight, or the action of the muscles connected with it, is generally sufficient to do. The extension is made by pulling on the lower portion of bone, by grasping the limb with one or both hands, and with the aid of one or more assistants, ac-

cording to the size of the limb, and the situation of the fracture. In many cases the surgeon by himself is able to reduce the fracture by grasping the upper portion of bone with one hand, and then pulling upon the lower with the other. As a general rule, the force should be applied through as few joints as possible; for then the force employed will have more power, and the ends of the bone will be more easily reduced.

Before making extension upon the limb in order to reduce the fracture, it should be placed as nearly as possible in that position in which it is intended to keep it during the after-treatment; for it often happens that the least alteration from the position in which the bones remain quiet after having been reduced, is sufficient to bring on spasm in the muscles, and to displace the fractured ends; and to render it necessary to go through the whole operation of reducing them again,—giving the patient great pain, and interfering with the process of union, if it have to be repeated often after the callus has commenced to form. Nothing, I believe, is so injurious to the union of a fracture, as moving the ends of the bone about after they have been once reduced, and destroying their apposition during the first part of the ossific process; for without this be allowed to go on quietly and without interference, the ultimate union of the bone may be deferred till a very late period, and often be prevented altogether. Many cases of non-union occur, in which the evil has depended on the disturbance of the fractured ends of the bone during the first part of the ossific process, by the surgeon changing the apparatus frequently, first trying one kind and then another, and moving the portions of bone about as soon as the callus was commencing to form. The

surgeon should always consider well what apparatus or position is most likely to answer the purpose before he applies it, and not adopt any one hastily, which, by and bye, he is obliged to remove. I believe that in many cases, it would be better to defer the reduction of the fracture altogether until the proper apparatus could be got; or till the patient could be placed in the position, from which he will not have to be removed afterwards: for the ends of the bone remaining in their original position, although displaced, will do less harm, than reducing them once, and then having to alter their position again; by which they will become a second time displaced, and require a second reduction to bring them into apposition; and this cannot be done without doing mischief to the soft parts, and interfering with the process of union.

The reduction of a fracture can generally be effected without much difficulty, the power of the muscles being easily overcome. There are cases, however, where many obstacles combine to oppose it; and the greatest is the action of the muscles. Sometimes the muscles act with so great a degree of spasm, that it is a long time in subsiding, and prevents the fracture at first being reduced : this is dependant on many circumstances. The simple spasm, or tonic contraction of a muscle after a fracture, where there is displacement of the portions of bone, is owing, I believe, to the resistance which naturally acts against the muscular fibre being removed, and it then becomes shortened by what is called its tone. This tonic contraction in ordinary cases is not sufficiently powerful to resist extension, if it be made gradually and continuedly for a short time; but if allowed to remain for a long period, as when the fracture is not attempted to be

reduced till some time afterwards, it may become so fixed, that then a very powerful force is requisite to overcome it, and often it cannot be overcome at all; owing to the muscles having become accommodated to their altered position. This is well exemplified in those cases, where, from the peculiarity of the fracture, the ends of the bone cannot at first be brought into contact from the earliest period, as in some cases of fracture of the patella; it is found that although at first the upper portion of bone can be brought into contact with the lower, it cannot be in the course of a few days; for the shortening of the muscular fibre that has taken place has a tendency to become permanent, and to prevent the future approximation of the fractured portions altogether; and often does so completely, when the reduction has been defered for a great length of time. This slow and gradual contraction of the muscle, is what is properly called its tone; and is only an important obstacle, where it is allowed to exist for some time, owing to the ends of the bone not being reduced at as early a period as possible.

The spasmodic action of the muscles is quite different to the above tonic contraction, and may be produced in two ways; either by a continued irritant acting on the muscle, or by an occasional one which only acts when the position of the fibre of the muscle is altered. The continued spasm may be dependant on many causes;—as the sharp end of the bone pressing against the muscle; or the injury of one of the nerves; or the simple alteration in the position of the muscle, owing to the shortening of the limb, is in some cases sufficient to keep up a continued spasmodic action. The continued spasm of the muscles, however, is not

so frequent an attendant on fractures as the occasional spasm; for in the majority of cases it will be found, that while the limb is lying quiet and having no extension made upon it, the muscles remain quiet also, but that as soon as reduction is commenced, spasm comes on, although it generally can be easily subdued.

The mode of overcoming this spasmodic action of the muscles, thus becomes one of the important points in the management of the reduction of a fracture, and is very often one of the most troublesome and difficult parts of the treatment. The only rational way of subduing the spasm, is to place the limb in a position that most relaxes those muscles that are producing it; by which the fibres are shortened to their utmost, and the muscle no longer being upon the stretch, ceases at once to act. This fact then, in the majority of cases, points out an important part of the practice that has to be adopted during the treatment, and which was first so ably advocated and so largely practised by Mr. Pott; namely, to relax all the muscles of the fractured limb as much as possible during the reduction of the fracture, and to place the limb in that position during the treatment, that tends to keep them so relaxed. Relaxation of the muscles not only enables the fracture to be reduced with facility, but it also guards against future displacement of the portions of bone; for the muscles no longer have any disposition to act, and consequently will not move the fractured ends from their line of apposition, after being once placed there.

In some cases where the spasm of the muscles is very violent and continued, it often happens that the more they are pulled upon, the more spasmodically they act, and this action is so great, that the reduction of

the fracture is prevented altogether. There are, however, other cases where the spasm, though violent at first, gradually subsides before the expiration of four and twenty hours. Many plans of treatment have been recommended to subdue this spasm, such as the application of extreme cold, or hot fomentations, the taking away of blood generally, or by giving nauseating doses of antimony; the object being to depress the muscular power of the system generally, and through the system, those of the fractured limb itself. The antimony, perhaps, is preferable to the general blood-letting, as these cases where the spasm is so very violent and obstinate, occur most frequently in the compound fracture; when as little depletion as possible should be employed, as the drain upon the system that has to ensue during the cure of the injury, is very great from the suppuration of the wound that takes place.

The peculiar direction of the fracture, sometimes so locks the ends of the bone together, that the least action of the muscles is sufficient to keep them there, and to prevent the reduction. In these cases, the direction the fracture has taken must be ascertained if possible, and the force so applied that the ends of the bone may be unlocked, by first pressing them from one another, and then pulling upon them. It is not uncommon in the compound fracture of the tibia, as will be more fully explained hereafter, to have to remove a portion of the bone before the reduction can be effected, owing to the fracture being so oblique, that the ends of the bone ride so much upon one another, that it is impossible to get the projecting portion back again into its place. It sometimes happens that a portion of muscle gets between the ends of the

bone ; and I believe that this may and often does present an obstacle to the reduction of the fracture, and that it exists more frequently than is supposed, more particularly where the bone fractured is surrounded by muscles, and where the fracture is very oblique, so as to make the one portion of bone very sharp and thin, which will easily project into the substance of the muscle, or between the layers of the different muscles. Nothing can be done in these cases, without there be a wound leading down to the fracture, and one sufficiently large to allow of the part being freely got at ; and then very likely little or no good would be obtained, owing to the difficulty of disengaging the entangled portions. The result of these cases is, that the intermediate portion of muscle sloughs and separates, from the pressure upon it.

It is often necessary to produce a kind of lateral or see-saw motion during the reduction of a fracture, at the same time that the extension is being made ; for the fractured portions may be so locked together, that simply pulling upon them is not sufficient to disengage them. This is often exemplified in fractures of the tibia, or of the bones of the fore arm, where the fracture takes place with a more irregular surface than in the humerus or femur.

The next point to be ascertained, after the fractured ends of the bone have been reduced to their natural position as much as possible, is the means that are to be employed in order to preserve the correct apposition of the portions of bone, and to keep them as much at rest as possible ; and here it will be found that the two principles already mentioned, when speaking of the spasm of the muscles, have to be carried into effect, namely, the extension of the limb in some cases,

and the relaxation of it in others: so that this part of the treatment may be divided into two kinds—the treatment by *extension*, and the treatment by *position*: and I shall mention the general points about each, and the principle of the various mechanical contrivances that have been invented, in order to keep the fractured portions of bone in apposition and at rest.

The treatment by *extension*, implies that mechanical violence is the chief means by which the ends of the bone are reduced, and by which they are kept in apposition during the time that the process of union is going on. As a general rule, I believe this mode of treatment to be bad, for it often acts so as to continue the spasmodic action of the muscles, and in fracture of the larger bones, which are surrounded by very powerful muscles, it cannot but be injurious from the violence it is necessary to apply to the limb generally; as well as being liable to interfere with the process of union in many cases.

The treatment by extension consists in the employment of some kind of splint, which gains its fixed point on the neighbouring joint above the fracture; so that a force telling upon the lower portion of the bone at the lower end of the splint, will have no effect in pushing the splint upwards, and must, therefore, if made with sufficient power, act upon the lower portion of bone, and bring it downwards; and keep it there if the splint and bandage be well adapted to the rest of the limb. An example of this may be taken from the treatment of fractures of the thigh, by what is called the long splint; where the fixed point or counter-extension, as it is called, is gained by means of the splint being fastened to the pelvis, while the lower part of it tells downwards upon the foot,

and so pushes the lower portion of the femur with it, for the bandage which is attached to the upper part is immoveable, on account of the pelvis being the fixed point; and consequently any force that tells below it, must cause the lower part of the limb to move downwards; which force then becomes the extension: so that what is called the treatment by extension, consists essentially of two forces acting in opposite directions, the one telling at the upper part of the limb, being the counter-extension; and that telling on the lower part, being the extension.

The objections to the treatment by extension are, that when spasm exists in the muscles, it only tends to increase it; and when it does not exist, it often brings it on. I am aware that, in many cases, by continuing it for any length of time, the power of the muscles may be overcome, and the ends of the bone brought into their proper place; but the actual violence necessary to do so has often been so great as to injure parts of the limb; and when the reduction is gained, the position the bone is placed in by this very extension is such, that there is always a disposition to displacement, owing to the muscular fibre being kept upon the stretch, instead of being relaxed, and so removing all disposition to spasm.

Those cases where the treatment by extension is to be alone recommended, are in fractures near to some of the large joints, such as the hip; and here it is found that the muscles act so powerfully, and are so peculiarly situated, that the limb cannot be placed at an angle sufficient to relax them, at the same time that the flexion of the joints, in some of these cases, tends to displace the portions of bone: a very oblique fracture may also require the employment

of extension; but, as a general rule, I think it should not be employed, except when the treatment by position, as it is termed, has failed to produce the desired effect.

The treatment by position implies just an opposite principle to the treatment by extension; for while in the latter kind, mechanical violence is the great means by which the ends of the bone are reduced and kept in apposition, in the former all depends upon the relaxation of the different muscles as much as possible; by which all disposition to spasm is removed, and the ends of the bone lie quietly in contact until the union is produced; that position of the limb being adopted which the anatomy of the muscles tells us relaxes those that appear to be the chief agents in producing the displacement.

All the various kinds of apparatus that are employed to preserve the limb at rest, where the treatment by position is recommended, have for their object the steadying of the bone generally, and the joints immediately beyond, which are connected with it. They are also made of separate pieces, to admit of their adaptation to the various positions that may be necessary in different cases, when the relaxation of the various muscles is with difficulty obtained, as well as the exact apposition of the fractured ends of the bone. The mechanism of each apparatus will be explained when speaking of the treatment of particular kinds of fracture. As a general rule, those that are the simplest, at the same time that they fulfil the object for which they are intended, will be found to be the best; for not only are they the most easily applied, but they are also the most easily obtained. It frequently happens that a fracture may be treated without applying any

mechanical contrivance at all, when the position so completely relaxes all the muscles, and where the fracture takes a direction that the ends of the bone are easily kept in contact, without any tendency to slide from their apposition, after being once reduced. In these cases, the limb need only be placed upon a pillow, taking care that it is firmly supported, so as to present an even surface for the bone to lie upon. In the majority of these cases even, it will be found prudent to support the limb generally with a light splint, with the intention of guarding against displacement, rather than mechanically to confine the limb; for as soon as mechanical force becomes necessary, it implies that the muscles are disposed to act, and to draw the portions of bone from their contact; and if simple position be not sufficient to prevent this, some more powerful means must then be employed.

It is the fact of many fractures getting well by position only, that I believe has led some surgeons to adopt the erroneous opinion that splints are altogether useless, or any mechanical contrivance that tends to keep the ends of the bone in apposition. How far such an opinion is correct, any one who has had much experience in treating fractures must be able to judge; for there are many cases that absolutely require mechanical means to steady the portions of bone, while the majority of fractures are benefited by splints of some kind. I am inclined to think that those who advance the sweeping assertion of splints being useless, have formed their opinion upon very limited experience, and judge of single cases that may have got well under their care without their employment, instead of taking the majority of cases, which are always

benefited by their use, and many of them absolutely requiring it.

An important point to be attended to in the treatment of fractures, is the mode of bandaging the limb. There are certain general principles to observe, which are applicable to all kinds, while there are others also which require consideration according to the particular bone the fracture happens to be in, and which are the only means to be employed for their treatment; such as fracture of the clavicle, sternum, ribs, scapula, and pelvis. These cases do not admit of the application of splints at all; the modes of applying the bandages to them will be explained, when speaking of each of the above kinds of fracture. I shall now only speak of the general principles that are to be observed in bandaging a fracture, in whatever situation it may happen to be.

The object to be gained by bandaging a fractured limb, and which the surgeon should endeavour to obtain, are threefold. The first is to make the pressure equable throughout, so as to prevent the circulation being impeded by any uneven constriction that the splints or kind of apparatus employed might exert. The second is, to confine the muscles generally, by which their disposition to spasm will be prevented. The third is, to fix the apparatus or splints, by which the ends of the bone are to be steadied, and their line of apposition preserved. The first intention of the bandage, namely the equalizing the circulation, will be gained by putting the bandage on the limb in such a manner (whether it be the upper or lower extremity), that it may press most at the point furthest from the centre of the circulation (which is the end of the fingers

and toes), and do so less and less as it approaches the upper part of the limb; for the pressure tells mostly upon the cutaneous veins, which are bringing the blood back to the heart, and any obstruction that is made upon them, will of course cause the part below the constriction to swell and become œdematous. If it be the upper extremity then in which the fracture exists, the bandage should be commenced at the fingers; and if in the lower extremity, at the toes; making the pressure less and less as it advances upwards, and taking care not to constrict one part more than another. Another object gained by the first bandage is, the protection of the skin from the irritation of the splint or apparatus, of whatever kind it may happen to be, that is employed for the treatment of the fracture. The muscles are at the same time pressed upon generally throughout, and their disposition to spasm diminished, and oftentimes prevented altogether.

The third object of the bandage, namely, that of confining the splint, admits of no other rule being laid down, than to take care that it fixes it firmly, and that it does not press unevenly or more at any angle that may exist in the limb, owing to the position of the various joints. The limb should always be placed in that position during the bandaging of it, that it is intended to keep it in afterwards during the treatment; for any alteration after it is once applied, as from that of extension to flexion, will produce constriction in some part of the limb more than another, and cause the bandage in other parts to become loosened.

As a general rule, it will not be safe to bandage a fractured limb immediately after the receipt of the injury: and in those cases where circumstances allow of this being done, the pressure must be much less at

first, than may be made at a future period; for swelling is always to be expected round the ends of a fractured bone, though it does not always take place; and then, if the pressure at first be great, it will not allow of such swelling, but will cause constriction and produce mischief in the limb, if it be allowed to continue, by increasing the inflammation. In many fractures a bandage cannot be borne till some days after the receipt of the injury, particularly when it is near to the joints, or when there is much ecchymosis present: for in these cases the swelling comes on almost immediately, and continues increasing up to a certain period, when the inflammation, or the effusion, of whatever kind it may be, subsides; and then, very often, slight pressure assists in the further diminution of it, by producing a quicker absorption of it than otherwise would take place: but in all these cases it should be very cautiously done, for the inflammation is very soon brought back again, if the pressure be imprudently applied. It is not necessary to refute the old notion of applying a bandage in order to compress and mould the callus to its proper shape: for, from the knowledge that now exists as to the manner in which the callus forms, we find that that which the older surgeons called an unnatural formation round the ends of the bone, is nothing more than a necessary part of the process, which nature employs to repair the injury, and which experience tells us should be interfered with as little as possible, if we expect the bone to unite quickly and firmly.

With regard to the local application in simple fractures, little more is necessary than to keep the part cool with some evaporating lotion: for in the majority of cases the swelling and pain that exist soon subside,

and the part recovers itself gradually, if the bone has been properly placed in apposition, and care taken to guard against displacement. Simple fracture into the joints, however, requires more active treatment; for now not only does the swelling from ecchymosis come on, but the joint itself becomes inflamed, and requires to be treated by leeches, fomentations, and poultices, according to the kind of inflammation present. Ice is of great use in these cases of fractures into the joints, when applied immediately after the receipt of the injury; for it prevents both the effusion into the joint, and the vessels from taking on that active inflammation that they otherwise would be disposed to do. I am convinced that I have seen cases where the joint has recovered much sooner, and where it perhaps would not have recovered at all, if the ice had not been continually applied from the first receipt of the injury. The mode of applying the ice, is to pound a sufficient quantity of it to cover the joint, and then to put it into a pig's bladder: the water, as it forms by the ice dissolving, keeps its cold temperature as long as any of the solid ice remains; and need not be changed until it is all melted, when a fresh portion may be put into the bladder.

A large soft linseed-meal poultice is of great service, where there is much tension of the skin from ecchymosis, or from any other kind of effusion. General blood-letting is seldom required in the simple fracture without the patient has received other injuries at the same time; and then it may become necessary on this account, but not for the fracture only.

Fractures into joints admit of no mechanical confinement, as a general rule, until a very late period after the receipt of the injury; for here the swelling

that comes on precludes the application of all pressure, owing to the inflammation which so soon shows itself in a delicate part like a joint, after a fracture into it. The treatment in these cases should be to place the limb in the position which gives the most ease to the patient, and which at the same time supports the limb generally, and keeps the fractured portions in as correct a line of apposition as possible, avoiding all unnecessary pressure on the joint itself. In all cases of simple fracture, it will be well to keep cold lotion applied for the first week or ten days; for it gives relief to the patient by subduing the aching pain that generally attends this kind of injury, as well as tending to keep down the inflammation.

OF COMPOUND FRACTURES.

A fracture is said to be compound when it is accompanied by a wound of the soft parts round the bone which communicates externally with the air. A simple wound of the integuments and muscles, however, does not constitute a compound fracture, without it lead down to the fractured ends themselves; for it often happens that a fracture is attended with bruising or laceration of the soft parts, and yet there is no communication with the fracture. These cases are found to differ greatly as to their results; for while the compound fracture is a very dangerous kind of injury, and one that always takes a longer time to recover; the latter case, as far as the fracture is concerned, will recover in the usual time; the union of the ends of the bone taking place within the usual period, and the wound being a longer or a shorter time recovering, according to its kind and the extent of it.

The compound fracture is produced by the same kind of force as the simple fracture; the only difference being that it acts with greater violence, and produces more mischief to the surrounding soft parts. When the indirect force acts to produce the compound fracture, it generally happens that the ends of the bone are driven through the skin and muscles from within outwards, so that no more parts are injured than the ends of the bone come in contact with. It is different when the direct force acts, for then the extent of injury done to the soft parts need bear no relation to the fracture, but may occupy the whole limb, and still the bone itself may only be broken in one place. The difference in the mode of action of these two kinds of forces is important to remember, as it will influence the opinion that it may be necessary to form, as to the propriety of removing the limb at once, immediately after the receipt of the injury. Amputation, in by far the greatest number of cases, is performed when the fracture has been produced by the direct, than when by the indirect force; for the former kind crushes and destroys the vitality of the soft parts, whereas the latter only produces laceration, and causes little or no bruising, and consequently much less mischief. In the former kind, sloughing is to be expected, and often to an extent to expose the bone; in the latter, no such evil occurs, but merely local inflammation and suppuration from the wound.

Nothing is so difficult or requires nicer judgment, than to form a decision as to the propriety of amputating in some cases of compound fracture; and the difficulty is increased by the knowledge of the fact of so many cases having recovered, which have at first been condemned and pronounced as hopeless, by

able and experienced surgeons; when it has happened that the patient would not consent to have the limb removed. The difficulty, however, does not only exist with regard to the state of the limb itself, but with the constitution of the patient, for there may be two patients with precisely the same extent of injury attendant on the fracture, and the fracture itself may be in the same part of the limb, and yet there may be so great a difference in the strength of the constitutions of the two, that in the one case, the limb will recover without any bad symptom arising; while in the other, if the limb be left on, it may ultimately require to be removed, and perhaps the patient may lose his life, from the irritation produced to the system generally. It becomes important then, to consider both these points, before deciding upon the question of amputation, and not to look to the state of the limb merely, but to weigh both well in the mind first: by ascertaining, if possible, the previous habits of the patient; the strength of his constitution; and the state of his health generally; also, by paying particular attention to the condition of the limb itself, considering the kind of force that acted upon the soft parts, whether they have been crushed or torn—how far they are separated from the bone—whether any great vessel has been wounded—and if the fracture be comminuted, whether the portions of bone are completely separated, or are still adherent to the periosteum. It is of the greatest importance to ascertain the extent of injury done to the soft parts round the bone; for if they have been crushed, as by a heavy weight coming upon them, the consequences to be expected are, great sloughing and the exposure of the fractured ends, and great constitutional disturbance,

which may be sufficient to prevent the union of the fracture altogether, and very often to endanger the patient's life.

The *apparent* injury done to the soft parts, must not be depended on as the whole extent to which the sloughing will take place; for it not unfrequently happens, that it commences and spreads to parts which at first were supposed not to have been injured, because it was not then visible; but as inflammation sets up, the vitality of the parts becomes *tested* as to the power they may have of resisting the inflammatory action; and if they have no such power, what little vitality remained in them will be destroyed, and sloughing or mortification must take place.

It is not possible to lay down any fixed rules, with regard to the question of amputation in compound fractures; for particular points may exist, both with regard to the extent of injury done to the limb itself, as well as in the constitution of the patient, that may influence the decision in some cases more than in others. The following general points may be considered as influencing the decision in favour of amputating:—Where the fracture has been produced by the direct force, and this of a very violent kind, and of a nature very likely to have *crushed* the soft parts, and for a large extent of surface—where the fracture is much comminuted, and the portions of bone separated from one another, and of very small size, so as not to admit of being replaced in apposition, but which can only act as irritants to the parts around—where the wound itself is large and communicates for a great extent with the fractured ends of the bone—where one of the large arteries is torn through, in conjunction with great bruising of the soft parts—and,

finally, where the compound fracture extends into the large joints. Under any of these circumstances the limb will have little or no chance of recovering, and should therefore be removed.

In these extreme cases that I have just mentioned, the local injury is so severe, that the constitution of the patient does not require much consideration as to the propriety of amputating the limb; for, if it has been previously good, it will be sure to be broken up, during the process that nature has to perform in making attempts to save the limb, and so require the ultimate removal of it to save the patient's life; and, if his constitution has been previously bad, there will then be an additional reason for amputating immediately, as he is sure to die under the constitutional irritation that must necessarily arise after an injury of so severe a nature, if the limb be left on.

It may be said, however, are there no points to guide the surgeon in less extreme cases; where, although some of the above circumstances enumerated are present, there are others which are more favorable, and which might give the limb a chance of recovery? I believe that most of the cases of compound fracture, where it is thought advisable to try and save the limb, are those, where no two of the above urgent symptoms are present together. Thus, there may be a large wound accompanying the fracture, but the fracture itself may not be comminuted; or, on the contrary, there may be a comminuted fracture, and yet but little severe injury to the soft parts. A large artery may be wounded, and yet the fracture otherwise be of little severity; or the fracture may extend into the joint, and the soft parts around be but little injured. In none of these cases, should the limb be removed im-

mediately after the injury (as a general rule); but if any two of the above circumstances exist together, it will then be proper to consider the question of amputation; for the injury is then increased to a degree, that little hopes can be offered of saving the limb or the life of the patient, if it be left on.

The symptoms of compound fracture, with regard to the displacement of the ends of the bone, the motion between them and the crepitus, exist of course from the same causes, and are produced in the same manner as in the simple fracture; the only difference being, that the symptoms are generally more strongly marked, owing to the injury being greater.

It is often very difficult to reduce the ends of the bone in the compound fracture; for, in some cases, one of the fractured portions may protrude through the wound for an inch or more, as is often the case in fractures of the tibia, or in bad compound fractures of the lower end of the shaft of the humerus. The difficulty in reducing these kinds of fractures is twofold; depending, on the one hand, on the very small opening that exists in the integuments; on the other, on the very oblique line the fracture generally takes. In those cases where the end of the bone protrudes, it will almost always be found that the fracture has been caused by the indirect force; such as a person falling from a height and alighting on his feet, with the limb rather obliquely placed: under these circumstances the tibia or femur may snap across, and then the weight of the body and the velocity with which the person falls, will drive the ends of the bone onwards, after it has caused the fracture, and push either one or both of them through the muscles and integuments, according to the degree and direction of the

force applied. The fractured tibia, where the portion of bone protrudes, is by far more difficult to reduce than similar fractures in other bones; for the obliquity of the fracture, and the protrusion of the end of the bone are generally greater, at the same time that the opening in the integuments is generally smaller.

The treatment in these cases of protrusion of the fractured end of the bone is simple in its principle, though it is often very difficult to put into practice. Attempts should first of all be made to reduce the ends of the bone, as in the more simple kinds of fracture, by placing the limb in that position which tends mostly to relax the muscles, and then pulling the lower portion of bone from the upper, by making continued extension upon it for some time, and combining any degree of lateral motion with it that may be necessary from the peculiar direction of the fracture. It often happens that although the portions of bone can be brought into proper position, with regard to the length of the limb, they cannot be placed in direct contact, owing to the flap of skin on which the protruded portion of bone rests preventing it. In these cases, where it is evident that this portion of integument is the only obstacle to the reduction of the fracture, there can be no doubt about the propriety of enlarging the wound, in the direction that will free the end of the bone, and allow of its being replaced; for a slight increase to the size of the wound, will not produce any inconvenience so great as leaving the fractured end protruding, or as sawing off the projecting portion. In the majority of instances, however, it will be found that when the difficulty exists of replacing the end of the bone, that it is not dependant on the smallness of the wound only, but on the degree of action of the powerful muscles of

the calf of the leg as well, and upon the obliquity of the fracture. The only alternative in these cases, where a fair trial has been given to the ordinary means of reduction, is to saw off the projecting end of the bone, taking care to remove no more than is necessary to allow of the fractured ends being placed in apposition. It will not be found necessary always to remove the whole of the projecting portion; for, although it cannot be completely reduced, it still allows of some reduction, and that portion only which cannot be got back into its place should be removed: and before doing so, extension should be made upon the limb, and the point observed at which the reduction stops, for it is only the portion below this point that requires to be sawn off. Were the surgeon to remove at once the whole of the projecting portion, he would often deprive the patient, unnecessarily, of an inch or more of the bone on which he is operating.

In the comminuted compound fracture, where it is deemed advisable to give the limb a chance of recovering, all the loose portions of bone that have no connection with the periosteum or soft parts around, should be picked out from the wound, and the wound itself should be enlarged, if it be not sufficient to allow of this being done; for if they be allowed to remain, they will be sure to produce irritation and mischief, that might have been prevented by their removal. The enlargement of the wound in these cases will be beneficial in other respects also, by relieving the limb of the tension, and by allowing the matter to flow freely out that is sure to form under these circumstances.

In dressing compound fractures, the first point to be attended to, is to fix the whole limb, so that the portions of bone may be steadied: and the best mode

of doing so will be described with the treatment of each particular kind of fracture. As a general rule, the easiest position to the patient, and the one that presses least upon the wound, will be the best: and this may be done either by the employment of splints or pillows, or by the combination of the two. The local applications must be simple and light; the great object being to avoid pressure on the wound, and to allow of the free escape of the matter that must form: for the only way to keep the inflammation confined to the original wound, is to keep the parts around it lax, and to let it discharge freely, at the same time that the fractured ends of the bone are disturbed as little as possible. One great object that the surgeon should have in view in adopting a position for the limb to be placed in, is to choose one that allows of the wound being easily dressed, without the necessity of disturbing the limb, generally, each time the first dressings have to be applied to it. There are cases, however, where no such position can be adopted, owing to the peculiar situation of the wound, or to the great extent of it. Under these circumstances the fractured ends must be disturbed each time the limb is dressed; but precaution should be taken to do so as little as possible; and not to change the dressings oftener than is absolutely necessary.

In dressing the wound itself, the surgeon must be guided by its nature, as to the local application he makes to it; for the direct force will produce a different wound to the indirect, and the consequences that follow will be different also; for the compound fracture, when produced by the indirect force, can often be converted into a simple one, by bringing the edges of the wound together immediately after the

fracture: and when the wound is small, and there is reason to believe that the parts underneath are not much injured, this may always be attempted, by placing the edges nicely in contact, and keeping cold lotion constantly applied. This plan, however, does not always succeed; for, although there may be a tendency in the skin to unite, the muscles below may not do so; but inflammation sets up, and suppuration takes place, causing the wound to be opened, either naturally or artificially, to let the matter out before the parts will heal. When the compound fracture is produced by the direct force, it is seldom possible, nor indeed is it advisable to try and get union of the wound at first, for the inflammation in these cases almost invariably runs on to the suppurative stage, and the wound will then heal by granulation only. The lighter the dressings are in these cases the better; and the best application, for the first four and twenty or eight and forty hours, is a piece of simple dressing, or oiled lint, placed over the wound; and if there be any disposition in the soft parts to fall from the bone, which there seldom is without there be much laceration, they may be supported by strips of adhesive plaster, applied so as not to press or to constrict the wound sufficiently to confine the matter. In the compound fracture, accompanied with *laceration* of the integuments, great benefit is often derived from the judicious application of the plaster; by supporting the edges of the wound, and by bringing them more into their natural position; even if it be not advisable to try and get union by the first intention throughout. As soon as the state of the wound shows that the suppurative stage is commencing, the dressings should be discontinued, and poultices applied, and they should

be kept on, changing them three or four times in the twenty-four hours, until the wound begins to granulate, and puts on a healthy appearance. In fact, the wound is to be treated exactly in the same manner as the wounds of a similar nature unattended with fracture: for the fracture alters but little the treatment, and all that has to be done with regard to it, is to keep the ends of the bone as much at rest as possible.

The constitutional effects that attend the compound fracture are the circumstances that make the injury of so serious a nature; for it often happens that in cases where it has been deemed advisable to try and save the limb, owing to the favorable condition of the wound and fracture, the constitutional symptoms run so high, and produce such an effect upon the system generally, that the patient sinks beneath them, and often dies. It is the knowledge of this fact that makes it so difficult to decide, in some cases, as to the propriety of amputating. But, as already stated, where the nature of the injury itself is not one to warrant the removal of the limb, that this circumstance of *some* patients dying, is not a sufficient reason to draw a general conclusion from, and to say that a chance should not be given to a similar case when met with again, and where all things appear to be favorable, and likely to ensure the recovery of the limb;—otherwise, almost every case of compound fracture would be condemned, and patients would often lose their limbs unnecessarily.

The constitutional symptoms that attend compound fractures may be divided into three stages:—1st. Those that are the immediate effects of the shock upon the system, which may be called the *immediate* or *inactive* symptoms, from the fact of their existing while the

system is in a state of inaction, and in extreme cases, of collapse. 2nd. Those that arise as soon as the system begins to react, and which are quite opposed to the former, and may be called the active or inflammatory symptoms, from the effects they produce upon the system generally, and upon the wound itself. 3rd. Those that follow the active stage, which either return the system of the patient to its former state, or else destroy him, from the low fever and general debility that they produce. This latter stage may be called the passive, typhoid, or terminal stage. It may be called passive, because it altogether depends on the previous stage, as to the mode in which it ends; for if the patient has had strength enough to bear up with the second, he may recover; but if not, he may sink from the low or typhoid state into which he is brought.

The immediate or *inactive* stage, exists directly after the injury, and lasts during the first four and twenty hours; seldom longer, and often not so long. The symptoms of it vary much in degree, and are dependant on the general shock produced to the system at the time of the receipt of the injury, which tends to depress the vital powers generally. In extreme cases, the pulse is small and low, and often imperceptible, the face pale, and the surface of the body cold; vomiting is often present, independently of any injury of the brain, but merely owing to the irritability of the stomach caused by the shock to the system. The cause of this train of symptoms may be the loss of a large quantity of blood, from some artery being wounded at the time of the fracture; or they may exist with very little loss of blood, where the shock

itself has been very great, as when the accident is caused by some very violent and sudden force being applied to the limb. On the other hand, it often happens that the compound fracture may exist without there being any perceptible effect upon the system, during the first stage, but the pulse remains quiet and regular, without any alteration one way or another.

It is during this first or inactive stage, that the limb should be removed, if it be deemed advisable to do so at all; and yet it often happens that the system is so much depressed by the shock that caused the injury, that it is not possible to do so without immediately endangering the life of the patient. In these cases, the time must be carefully looked for when the pulse rises, and when the surface of the body generally begins to recover its warmth; and then the opportunity must be taken to remove the limb, before the reaction runs on to the second or active stage. Under these circumstances, where the system is so low, and where it is deemed necessary to amputate as soon as possible, every means should be taken to bring the patient out of this low state, as every moment is of importance for the future success of the operation. Stimulants may be given, such as brandy, ammonia, &c.; and the body generally should be covered with warm blankets, and by applying warmth to the feet also; for the longer the patient remains in this state of collapse, the weaker the system will get, and be the less able to bear up against the effects of the second or active stage. If the nature of the fracture be not such as to warrant the immediate removal of the limb, the same urgent remedies need not be applied, without the patient be very low indeed; for now, time is not so

important an object to gain as it is under the former circumstances, where the severity of the injury requires amputation to be directly performed.

The second or active stage may be said to begin, as soon as the immediate or inactive one subsides; for then the system begins to recover the shock, and reaction commences; which merely means that certain symptoms shew themselves that indicate a general sympathy of the system with the local injury, such as increased action of the heart, which often runs on to produce great excitement to the circulating and nervous systems generally, and produces most active fever. This is by some called the *irritative* or *symptomatic* fever. It often exists in a very slight degree, so as not to disturb the patient, while at other times it runs so high as to endanger his life, and not unfrequently destroys it.

In the most favorable cases of compound fracture, the injury remains so completely local, that no febrile symptoms shew themselves, or at any rate they are so trifling that they cause no anxiety or fear as to their favorable termination. In some cases they may be present in a much higher degree, and require very active remedies to subdue them, but still they are not sufficient to endanger the patient's life. Whereas in other cases, as already stated, they often run so high as to cause the patient to fall rapidly into the third stage, when the low fever that comes on endangers his life; and if he have not sufficient stamina, and if proper active means be not taken to recover him, by giving every possible support in the shape of diet, he may sink and die from its effects.

During this second or active stage, the wound is generally more inflamed than at any other period; and

it is now that the inflammation spreads, if there be any disposition for it to do so; often running up the limb to a great extent, and affecting the lymphatics and absorbent glands above them. The state of the wound is at first the cause of the constitutional irritation that arises; but by and bye the fever may run so high as to react upon the wound, and alter the character of it completely, and cause a comparatively healthy wound to become sloughy and unwholesome, and destroy the soft parts in the neighbourhood, that otherwise, from the nature of the injury, would have remained unaffected.

Erysipelas and delirium tremens often attack patients during this second or active stage of the compound fracture. They are to be looked upon as accidental circumstances, and by no means as necessary consequences, for in by far the majority of cases they are absent. The dread of neither the one nor the other, deserves to be considered as a sufficient reason for removing a limb, if the fracture itself, though bad, still gives a hope of its recovery. For to say that erysipelas is to be dreaded, owing to the wound attending the fracture, rather than that caused by an amputation, is saying that it will attack one kind of wound rather than another, which experience tells us is not the case, for wounds of every description are liable to be attacked by it, and not one kind more than another. All that amputation would do in these cases, would be to make a larger wound and to render the patient much weaker, and so place him under circumstances much more favorable for the erysipelas to attack him; both from the wound as well as from the state of the system generally. The same reasoning may be applied to those cases where the patient is

attacked with delirium tremens; and where it may be asked, if the limb had been removed at first would not the delirium have been prevented? I believe that it would not, and that the chance of the patient being attacked by it would have been increased rather than diminished; for experience tells us that those persons, who are of a weak, irritable or excitable habit, either naturally or from the use of stimulants, such as spirits, &c., are the most easily affected by any shock or increased excitement that acts upon the system, and are also most easily affected by delirium tremens. What then would amputation do in these cases? why only increase this irritability of the system by causing a large and very painful wound, instead of a small and less painful one; at the same time that the strength of the patient is greatly reduced, both from the shock of the operation, and the drain upon the constitution afterwards from the wound. Under these circumstances, the patient would be much more liable to have delirium tremens, than if the limb were left on.

The treatment of the second or active stage, is much more difficult than either the first or third stages; for it requires very nice discrimination and great judgment to decide upon the line of practice that ought to be pursued. As a general rule, blood letting should be very cautiously employed in cases of compound fracture; for it has to be remembered, that the injury itself is of a nature that brings the patient very low; and that it is one that requires great energy to bear up against the drain that takes place from the wound, as a necessary consequence before it can heal. Large bleedings and powerful medicines will be liable to cause the active stage of fever to run on quickly to

the typhoid, and very soon destroy the patient. The pulse in these cases must not be taken as the sole guide with regard to the propriety of bleeding; for often after a few ounces of blood have been drawn, it sinks at once, and indicates that there is no strength of system to bear depletion.

The most minute enquiries should be made as to the patient's previous health, and mode of living, as to the kind of food he has been in the habit of taking, and whether he has been addicted to drinking ardent spirits, &c.; all these points will decide as to the probability of the patient being able to bear much depletion or none at all, and will indicate accordingly, the mode of treatment that ought to be adopted.

Amongst the lower classes, there are many who get no wholesome food, and who at the same time are in the habit of taking large quantities of stimulating liquors: these people if affected with any severe injury, are very liable to be attacked with delirium tremens, and more particularly if any blood has been taken from them, either by the wound attending the fracture, or by the use of the lancet. The impropriety of bleeding in these cases is shewn by the kind of treatment that gets them well; for instead of using medicines that have the effect of lowering the system generally, it is necessary to give those that have the contrary effect; such as bark, opium, and ammonia, and to combine them with good wholesome diet; such as beef tea, arrow root, &c., at the same time that porter and wine are given occasionally with them. As a general rule with the patients that are admitted into hospitals, I have observed that when they are attacked with delirium tremens, the liquor that they have been in the habit of drinking does them most good, which

point can generally be ascertained either from the patient himself or from his friends. It appears that the stimulus to which the system is accustomed, has more power of allaying the excitement and irritation, than a new one, which often tends to increase it.

The use of opium in delirium tremens is ~~of~~ very great ~~use~~ when administered at the proper time; and it will be found to have much greater power in checking the disease at its commencement, than it has of subduing it when it has once got to its height. To be of any advantage, it should be given as soon as the first symptoms of the delirium shew themselves, which are generally indicated by the patient's countenance looking more excited, and by his eyes becoming brighter, and restless, being in constant motion from one object to another. He also begins to talk incoherently, asking absurd questions, and mixing up many different subjects in the same sentence. But one of the most important symptoms is the want of rest at night, for he gets no sleep, nor shews any disposition to have it. All these circumstances should be looked for after a compound fracture; for if they be not checked, they go on increasing, and the whole system becomes excited; and the patient gets so violent that he requires to be restrained. The opium should be given immediately on any suspicion that delirium is coming on; and it should be given in very large doses, from half a drachm to a drachm or a drachm and a half of laudanum, according to the excitement of the patient: for I am convinced from my own experience that a large dose, administered as soon as the symptoms show themselves, will have more effect in checking the disease than small doses often repeated afterwards, or than the same large dose would if given at a later

period, after the disease had existed some time. And it is surprising how large a quantity of opium the system will bear, while under the excitement of delirium tremens, compared with other diseases: for in those cases that die, it is found impossible to procure sleep at all, but the excitement exists till the last, and the patients die from sheer exhaustion. I have often watched patients affected with this delirium, and have seen them continue to pull and to exert themselves to the very last against the straps that confine them, and have heard them continue talking in the same incoherent manner until a very few minutes before their death; when their physical force appeared to fail them all at once, and the heart ceased to act. If the opium prove of no service by the mouth, it may be given in a clyster of gruel or starch, putting a drachm or two drachms into it. Dupuytreu recommended this mode of administering the opium in delirium tremens, in preference to giving it by the mouth, and speaks of its effects being more certain.

There is a curious point connected with the pathology of delirium tremens, whether the disease be traumatic or idiopathic (but I have more frequently observed it in the latter kind), namely, the condition of the heart. In almost all the cases that I have examined since I first made the observation,* I have found the muscular fibre of the heart so soft, that it gave to pressure under the fingers like a piece of dough; and could be moulded to any shape almost, if taken between the hands and rolled, so that it would be diffi-

* In the year 1831, while house-surgeon to the Middlesex Hospital, I observed, with Mr. Corfe, the apothecary, in every case that died of this disease, there was this peculiar soft condition of the heart.

cult to say which was its right position, without examining it minutely. This flabby soft condition of the heart fully bears out both the symptoms and the kind of treatment that most benefits the patient, and explains why depletion produces such bad effects, and often destroys the patient when it is practised.

The third, or terminal, stage of the compound fracture exists after the active, and is dependant on it for the turn it takes. Thus, if the active stage has been subdued before it produced any urgent symptoms, the system gradually becomes quiet, and the wound begins to look healthy and to heal: in fact, the only thing now required to get the patient well, is a sufficient length of time to allow nature to repair the local injury, and to give the patient strength; and this is done without the aid of medicine, by merely keeping the wound properly dressed, and giving good nutritious diet, and by keeping the limb at perfect rest. It may happen, however, that the second or active stage produces such effects upon the constitution, that the patient is reduced so low, that instead of recovering gradually, he continues to get weaker, and will ultimately sink if active measures be not taken to support him, and to give him strength to bear up against the low fever with which he is attacked, and which is sufficient to destroy him, if not stopped as soon as possible. The causes of this low or typhus fever are the great depression to the system generally, which the active fever has produced, as well as the drain upon it, that has been going on from the wound. The treatment in these cases is the same as the low fever requires that is present from other causes; the object being to recover the system from its weak and irritable state, and to give the patient power to regain his natural

strength of constitution. Bark, opium, ammonia, &c., must be given, according to the state the patient may be in with regard to the condition of his pulse, tongue, and skin. The opium in these cases is not of such decided service as in the delirium tremens, and should not be given when the skin and tongue are very dry. Beef-tea, porter, and wine, however, may be given freely, for all the patient wants is strength; and as he regains this, the tongue and skin will become moist, and the pulse regular and quiet; at the same time the wound will become healthy, and put on a granulating appearance, and begin to heal. In the low fever that attends this third stage of the compound fracture, support is wanted more than stimulants; whereas in the delirium tremens, stimulants are quite as important as the nutritious diet, and should be combined with it.

OF THE PROCESS OF UNION OF FRACTURES.

When a bone is broken, a certain process has to be gone through, which ultimately produces a substance that connects the two portions together. This substance, however, only fixes the ends of the bone at at first, without there being any actual union of the fractured surfaces, but merely locks them together, by surrounding their extremities with a kind of mould, which acts as a circular splint, and retains them in apposition until the process of union has extended to the fractured surfaces themselves, and made the two portions one continuous bone again; the external mould is then absorbed, and the natural shape of the bone returns. This substance, from its hardness, and which in fact becomes bone, has been termed the *callus*. It

is divided into two kinds, owing to its formation having two distinct periods, as well as two distinct offices. Thus the first, or external callus which forms, is merely designed to fix the ends of the bone together, until the fractured surfaces are actually united by bone again, and become continuous; it has on this account been termed the *provisional callus.* The second part of the process, which consists of the actual junction of the two portions of bone, by the ossific process extending between them, and so forming the bone into one continuous mass again, and which becomes permanent, and returns the bone to its former shape, has been called the *definite callus.*

It is not my intention to consider the old theories that formerly existed with regard to the mode of formation of the callus, for they are now quite exploded, and are proved to be erroneous from the numerous experiments that have been made of late years. I shall only lay before the reader generally those points that explain the different changes that take place, both in the soft parts round the bone, and in the fractured ends themselves; and which are now ascertained to be correct, from experiments on animals as well as from actual observation on man.

When a bone is broken, the immediate consequences that take place are, laceration of the periosteum near to the fracture, bruising and tearing of the muscular fibre and cellular tissue round the ends of the bone, and the effusion of a certain quantity of blood into the neighbouring textures, and between the ends of the bone themselves. All these effects vary in degree, according to the kind of force that acts to produce the fracture, and the violence with which it is applied, and also upon the direction the fracture takes,

and the surface the ends of the bone present; for these circumstances will influence the extent of laceration in the various textures that are injured, and also the extent of effusion of blood that takes place in them, as it depends upon the number and size of the vessels that are torn through or wounded. The quantity of blood is, as a general rule, trifling; for the muscular arteries are the ones that are most frequently injured, the larger trunks in the majority of cases escaping.

The extravasated blood occupies the space round the ends of the bone, and extends between them and into the medullary cavity also; it then becomes coagulated, and retains this appearance for a short time, giving out, as it coagulates, a fluid which resembles serum, and which remains liquid for the first four and twenty or eight and forty hours. At the expiration of three or four days, this mass of coagulum becomes firmer in consistence, and glues the surrounding textures together, so that it is difficult, at this period, to distinguish the fasciculi of the different muscles in the immediate neighbourhood of the ends of the bone. The medullary substance becomes redder, and is seen to be injected with vessels as well as the periosteum, which is also more vascular than natural.

In the next stage, the mass of muscle and coagulum becomes paler, of a firmer consistence, and of a defined shape, taking more the form of a capsule round the ends of the bone, and beginning to exclude the adjacent muscles which gradually regain their shape and structure, but are still paler than natural. The space between the ends of the bone themselves, is occupied by the clot of blood originally effused, which is now of a greyer colour, and of a firmer consistence; the medullary membrane and marrow have

also become thickened and redder, owing to the increased vascularity that has taken place in them.

This thickening of the surrounding textures continues increasing, until it assumes the consistence of cartilage ; and then it forms a distinct capsule, which confines the ends of the bone within it, and is sufficiently strong at the end of ten days or a fortnight to steady and to keep them in their place, without any great violence be applied to them, when of course the bone will bend, as the capsule itself is not yet converted into bone. The substance between the fractured surfaces retains much the same appearance, and does not increase in hardness like the external capsule, though it is continuous with it, and seems to form part of it ; so that in fact the ends of the bone themselves, are still quite moveable, and could be easily displaced, were this external capsule not present.

The changes that next take place are very regular and gradual, so that it now becomes more difficult to separate the process into different stages, for the distinctive parts of it are less apparent. This period commences after the first fortnight, by the formation of small depositions of bone in the thick cartilaginous capsule, which can generally be found as separate nuclei before the end of the third week. The capsule itself becomes more defined, and the muscles, in the immediate neighbourhood of it, more distinct and more of their natural colour. These deposits go on increasing until the whole capsule is converted into bone, and completely locks the fractured ends together, the capsule however being continuous with them only at the points immediately beyond the fractured edges, and not with the fractured surfaces themselves, these being still only joined by the original soft intervening

substance, and as yet have no bony union to connect them.

Towards the end of the fourth week, the tumour or capsule diminishes in extent, and becomes more compact and homogeneous in its structure, and separates itself from the surrounding soft parts, so that the muscles begin to move upon it. More changes now take place in the medullary cavity of the bone, its membrane becomes swollen and thickened, and converted into fibro-cartilaginous substance, which gradually fills up the canal of the bone, and finally obliterates it completely. The plug which is thus formed, joins and becomes part of the same substance that is lodged between the fractured surfaces.

From the end of the fourth week to the sixth or eighth, the capsule becomes harder and harder, and is by this time converted into bone, a distinct periosteum can be traced round the tumour, which is found to be continuous with the membrane round the sound bone. The central plug continues to spread towards the fractured ends, and to increase in consistence, and ultimately is converted into bone.

From the third to the fifth or sixth month, the provisional callus, as the external tumour is called, becomes more compact; and the central plug undergoes the same changes. The substance which was placed between the fractured surfaces acquires all the character and consistence of the compact substance of bone, and is now called the definite callus.

In the last period of the formation of the callus, the central plug becomes thinner, and cells begin to appear in its interior, and which finally spread and become larger and larger, so as to leave the central canal of the bone free. A medullary membrane gradually

forms with the cells, and ultimately becomes continuous with the proper membrane, which secretes the marrow contained in the bone. The external or provisional callus gradually disappears, and leaves the bone of its natural shape.

The above description is drawn up from that given by M. M. Dupuytren and Breschet; and I believe it contains most of the important points that are as yet known upon the subject. For the minuter detail, which is exceedingly interesting in a physiological point of view, I must refer the reader to the various experiments which have been made by the above, and by many other surgeons and physiologists of high authority.* My object has been to give those points which are important in the practical treatment of fractures, by indicating the period at which the surgeon may depend upon the union of the bone being sufficient to allow of the splints being discontinued; at the same time that he must remember that the ends of the bone themselves become joined at a much later period, and are not actually continuous till five or six months after the fracture. M. Dupuytren sums up his description of the process of the formation of the callus, as presenting the following phenomena:†—" 1st. Effusion of blood and of a viscid juice, and a gluing together of the fragments. 2nd. Formation of ecchymosis in the tissues that surround the ends of the fractured bone; irritation and tumefaction of these parts. 3rd. Formation of a cartilaginous case, and bony exterior; and the development of a plug in the centre of the bone, formed by the swollen medullary mem-

* Sir Astley Cooper, Sir Benjamin Brodie, Messrs. Mayo, B. Cooper, Howship, Amesbury, &c.

† Leçons Orales. tome 4^me^.

brane, and which undergoes the same transformations. 4th. Ossification of the substance between the fragments. 5th. Diminution of the callous tumour; re-establishment of the medullary canal; return of all the parts that surround the bone to their natural state. It is seen, after what has been said, that the period of forty days, fixed by many surgeons for the consolidation, is far from being sufficient; and that it ought to be much longer in the oblique fractures, and in those where the fractured extremities ride upon one another."

OF UNUNITED FRACTURES.

It is not uncommon to meet with fractures where the process of union takes a longer period for its completion, and where the ends of the bone do not become joined by ossific matter till some time after the ordinary limits which nature appears to have prescribed as the necessary ones, have been exceeded. The term non-union, or ununited fracture, is then made use of; which is applied rather technically, meaning that the consolidation of the ends of the bone has not taken place in the period that it usually does in the generality of the cases under favorable circumstances. The term might of course be applied to every fracture during the first two or three weeks, but it is not; for the non-union that then exists, is no more than observation and experiments tell us to be a necessary delay, before the process that nature employs can be sufficiently advanced, to form what is called the provisional callus, by which the ends of the bone are first held together.

There are many causes which may interfere with this union, the majority of which, however, are but little understood, and are advanced without any decided

knowledge as to their mode of action: for in many cases of fracture the patient is apparently in good health, and the ends of the bone well in apposition, and kept perfectly at rest, but still no bony union is produced, and the portions of bone remain connected merely by soft ligamentous substance, and often not even by this; the fractured surfaces then become smooth and rounded, and move more freely one upon the other, constituting what is called a "false joint."

The causes of this non-union are divided into *constitutional* and *local*. The former interferes with the process by first acting on the system generally, and then upon the part itself, while the latter may exist and act purely locally; the system generally having a disposition to favor, rather than retard the process, as is often seen from the deposition of bone that takes place in the neighbourhood of the fracture, though none exists between the ends of the bone themselves. The constitutional causes may act where the system is generally weak, and when the ordinary functions, that may be considered as the natural ones, are but ill performed, owing to there being a want of stamina to excite the different parts to action, which is necessary to enable them to produce certain effects, in order to constitute what is termed health. If these ordinary or natural functions are not duly performed, it is not surprising that any new one, that requires increased energy and action in the system for its completion, should be sometimes interfered with, or that it even should be altogether prevented: and such is the case where a fracture has to be united by the formation of a large mass of new bone, which process requires a great length of time for its completion, and a necessary stimulus to action in the various parts that have to be

called into play; which stimulus may be increased or diminished by the system being in health or disease, and may so favor or retard the process that must be gone through before such new bone can be produced.

Any increased or diseased action, which disturbs the system generally, may interfere with the union of a fracture; and there are many described as doing so. Phthisis, scrofula, syphilis, pregnancy, are all advanced as causes that may prevent the formation of the callus within the natural period, but of their mode of action we know very little; or, indeed, if really they have such power of prevention at all; for many cases of fracture get well quite as soon, and the ends of the bone become as firmly consolidated, with the above states of the system existing, as they do when they are absent altogether; shewing that in themselves they are not sufficient to oppose the formation of the callus, and that some other cause must exist. Until we have a very large statistical table, illustrating the comparative frequency of the union and non-union of fractures under the above circumstances, we can draw no decided or reasonable conclusions that they have in themselves the power of so retarding the process; for I believe that the few cases in which it is not completed, are the exceptions, and not the general rule.

There are some fractures, such as those of the neck of the femur, of the patella, and olecranon, that are found very rarely to unite by bone; but the cause of the non-union in these cases is different to that now under consideration; for the parts of the bone in which the fracture occurs being connected with the joints, explains to a great extent why union is so difficultly produced, and more particularly in fractures through the neck of the thigh bone, confined within the capsule,

for the ossific process is interfered with owing to the adjacent textures, which are so necessary to form the first part of it, being isolated completely from the fractured surfaces; the consequence of which is that the provisional callus cannot be formed, nor the definite one either, and the ends of the bone never become united by ossific matter. The peculiarity of these cases, however, will be more fully explained when speaking of fractures of the neck of the femur.

The term ununited fracture is technically made use of when the fracture exists in a part of the bone external to the joints, and in which, under ordinary circumstances, union takes place within the usual period. Some fractures unite more slowly than others, without showing any disposition for permanent non-union, but merely from the want of sufficient energy in the system, there is not the power to produce the callus within the ordinary time. In these cases the union in the end is quite as firm, though it is slower in being produced. In other cases the process seems to be interfered with, and no union at all takes place during the first month or six weeks, when the patient's constitution may recover itself and the system show more energy, and the bone may then suddenly begin to unite, and the process go on favorably to its termination. Finally, there are other cases in which no bony union takes place at all, nor do the parts shew any disposition to produce it. Under these circumstances a soft ligamentous substance remains between the ends of the bone which never becomes ossified, and if it be in a part where there is much motion of the bone, as in fractures of the radius, even this ligamentous substance is not formed, but what is called a false joint remains, and the ends of the bone become smooth and rounded,

and move freely upon one another, being retained in their place by a kind of capsule, which is lined by synovial membrane.

Motion of the fractured ends of the bone, when allowed to exist, becomes a decided cause of non-union; and this is to be expected, when the process by which bones unite is considered, for without the provisional callus can be formed, the definite one will not be, and the former cannot take place without perfect rest and quiet be given to the bone during the first part of the process. The constitutional causes, as already stated, are difficult to explain, except generally by supposing that any interference that may depend upon weakness of the system may be produced by want of action both in the constitution and in the part itself, and be sufficient to prevent the due performance of this as well as any other function. The existence of foreign substances between or by the ends of the bone becomes a local cause of non-union, and will remain as such so long as they be allowed to be present.

The treatment of these cases of ununited fracture is in many cases very unsatisfactory, while in others the most beneficial results can be obtained. The causes of the non-union may be divided into two kinds, namely, the constitutional and the local. The constitutional treatment must be governed by the symptoms present, and be administered accordingly: thus if the patient be weak and irritable, medicines and diet must be given to correct these habits of the constitution, so as to give more strength to the system and to increase the local action in the part in which the fracture exists.

The local treatments that have been recommended in these cases of ununited fracture are numerous, but

the object of all of them is the same; namely, to excite action in the parts round the fractured ends, and to make them throw out the material proper for the production of the callus. Blisters, friction, rasping, and the removal of the fractured ends, the seton and pressure of surfaces of bone against one another, have all been tried, and with various degrees of success. The application of blisters can only be of service when much action is not necessary, for the stimulus is required to be applied much deeper in obstinate cases, and closer to the ends of the bone than can be effected by the blisters: they may be tried in cases where the callus is slow in forming, rather than where it shews no disposition to form at all.

Rasping the ends of the bone, and the removal of them altogether, have been tried in many cases, and in some with advantage. The former operation consists in cutting down upon the fractured ends, and then paring off the soft ligamentous substance connecting them together. This often produces inflammation, and action enough to set up the ossific process in the neighbouring textures, and to form the callus. The latter operation is performed by cutting down upon the ends of the bone, and then, with a fine saw, removing them for an extent sufficient to make new surfaces, which are afterwards to be brought into contact and to be kept perfectly at rest. Both these operations have succeeded, and also failed in many cases. They are very severe ones, and very difficult to perform; and should not be resorted to till every other method has been tried and found to fail.

The other two methods of treatment, namely, the seton and the application of pressure to the ends of the bone, have perhaps proved successful in more cases

than the other kinds of treatment, and they are preferable to them, by not being so serious in their results or so difficult in their application. The seton is applied by passing a long flat needle, armed with a thick skein of silk, either between or close by the ends of the bone, and it is to be kept there till sufficient action is produced in the part to cause the adjacent textures to be excited to throw out the callus. The seton should be removed before it establishes a drain from the wound, which will be judged of by the effect it produces in the soft parts; it sometimes happens that constitutional disturbance is brought on by its employment, in these cases it must be removed directly, as more harm than good will be done by allowing it to remain: from a week to ten days, under the most favorable circumstances is generally sufficient to keep it in. It is not possible in many cases, to pass the needle between the ends of the bone, for the fractured surfaces may be so close in contact, as not to leave any space between them; all that can be done then, is to pass it as close to the fractured ends as circumstances will admit of, and to endeavour to produce action in their immediate neighbourhood, if it cannot be done directly between the ends of the bone themselves. After the removal of the seton, the limb should be kept at perfect rest, by applying one or more splints, and bandaging them well to it.

The application of pressure to the ends of the bone, I believe is the best treatment that can be adopted, at the same time that it is the simplest; and the one from which little or no constitutional irritation arises, which in the former kinds, is one of the greatest objections to their employment. The forcible pressure of the fractured ends against one another, has been largely prac-

tised by Mr. Amesbury, and in a great many cases with complete success; it is not always necessary to press them with the same degree of force, for some cases get well by simply steadying them more firmly than has been done during the former part of the treatment. Mr. A. gives a table, in his work on fractures, of seventeen cases of non-union, sixteen of which he succeeded in getting to unite, by making pressure on the ends of the bone, and by keeping them perfectly fixed afterwards. The non-union in all these cases, with the exception of one, existed, he says, "because the treatment adopted, and which is commonly recommended, did not prevent the fractured ends moving upon each other." This motion of the fractured ends no doubt, in many cases, is the cause of non-union, particularly where it exists to a great extent; but I am inclined to think, that in the majority of cases there is the absence of local action, independently of want of rest, and that some of the cases would not have united, had the pressure and strict rest and quiet been observed from the very first. That *slight* motion is not a common cause of non-union, is seen by observing the treatment of the majority of cases in hospitals, where such absolute rest as Mr. Amesbury describes as necessary is not attended to, and yet cases of non-union are very rare; for out of nearly four thousand cases of fracture that I have seen treated at the Middlesex Hospital, during the last ten years, there have not been more than five or six cases of non-union, (where the fracture has been external to joints), and none of the fractures are treated with that *absolute* rest which Mr. A. describes as being obtained only by his various kinds of splints. The common means are only employed; the object being

to gain position as much as possible, and relaxation of the muscles, which tend to produce displacement. In the cases of non-union, with the exception of one, the evil has existed on account of the patient being delirious or restless, from some other cause, and not allowing of the least rest to the limb, but constantly pulling it about, and moving it as soon as it had been placed in apposition. Under these circumstances, of course union will not take place, for it is mechanically prevented. In one of the cases that I have seen, the non-union was dependant on another cause, namely, the effusion of an immense quantity of blood round the fractured ends, which Mr. Mayo thought sufficient to prevent the first part of the ossific process commencing; the patient was under his care last year at the Middlesex Hospital. The case was that of a young man who fractured the humerus just above the condyles, but not into the joint: there was an immense deal of swelling when he was admitted into the hospital, which, from the discoloration of the skin, was evidently dependant on the effusion of blood; the bone did not unite within the usual period, and at the expiration of two or three months, Mr. Mayo passed a seton between the fractured ends. The bones did not take on immediate action, but after some time began to unite, and ultimately firm union was produced; the arm in the mean time being well supported by common lath splints. Mr. Mayo reckons, and I think very justly, that a large quantity of blood effused round the fractured ends, may become sufficient cause to interfere with the union of any case of fracture, if not to prevent it altogether; for it must be very difficult under these circumstances, for the primitive capsule or provisional callus to form, and if this part of the

process cannot be completed, the actual union of the ends of the bone cannot be effected, for the one is dependant on the other.

Pressure may be applied to a fractured bone vertically, by making it tell through its long diameter, or transversely by applying it laterally against the sides of the bone. The former is more easily employed when the injury is in the lower extremity. Mr. Amesbury's apparatus for fractures of the lower extremity is very convenient for these cases, for it allows the patient to walk about, without fear of displacing the ends of the bone. If the fracture be in the leg, however, a more simple contrivance will very often answer the purpose as well; by strapping the whole limb first of all evenly and firmly with soap plaster, spread on very thick leather, taking care that the different strips overlap one another closely, and leave no part uncovered, commencing at the toes and carrying it up to the knee; four thin lath splints should then be applied, the anterior one being made very flexible and long enough to pass before the instep; two of the splints are to be broader than the rest, and placed one on the outer, and the other on the inside of the leg, long enough to extend down to the sole of the foot, beyond the ankle, and hollowed out to admit the prominences of the lower ends of the tibia and fibula. The fourth splint should extend from above the knee joint, being placed behind to prevent it bending, and long enough to reach the heel. When the splints are well placed, and are made to fit the leg well, they should be firmly bandaged to the limb, making more pressure opposite the fracture than on the rest of the limb generally. The patient may now get up, and gradually make pressure on the ends of the bone, bearing his weight

upon the fractured limb more and more as he gains confidence in putting the foot to the ground, which he must do by walking more upon the heel than upon the toes.

In fractures of the bones of the upper extremity, the pressure admits of being made laterally, more than in the direction of the long diameter of the bone. The object of the splints must be to steady the bones well, and to prevent all motion between them, at the same time that they are pressed upon laterally by them, tightening the bandage more at the point of fracture than elsewhere. In the fractures of the humerus, where non-union exists, the crutched splint will be of great service, which is described under the treatment of fractures of this bone, for vertical pressure can be made by it as well as the lateral.

The length of time for continuing the pressure in these cases of non-union, will be indicated by the progress the case makes, and by the state of the limb generally; for it must of course be discontinued if it do more harm than good, by producing irritation and inflammation; it however gives the limb by far the best chance of recovery, and should have a fair trial before it be pronounced as useless.

ON

THE CAUSES, SYMPTOMS, AND TREATMENT

OF

PARTICULAR KINDS OF FRACTURE.

FRACTURES OF THE FINGERS.

The fingers are composed of many short bones and of many joints, which render them incapable of offering a resistance sufficient to allow a force to tell upon them, without there be also a resistance on the opposite side. It is on this account, that fractures of the fingers are more frequently compound than simple, the injury usually being caused either by a heavy weight falling on them, or by their being crushed by machinery, &c.

The kind of force necessary to produce compound fracture of the fingers, causes the accident to be of a much more serious nature, with regard to the part injured, than in fractures of other bones; for the force telling on both sides is acting in two opposite directions, and must consequently bruise the integuments and surrounding soft parts more or less, according to the degree of force applied. It is not then the fracture of the bone that makes the accident of so serious a nature, but the injury that is done to the parts around it, which is often so great as to render amputation necessary.

When simple fracture of the fingers occurs, it is generally found that the force has been of such a

nature, that it overcomes the want of resistance in the part by the great velocity with which it is applied; as when any hard body, such as a stick, strikes the finger a smart blow, it may have sufficient power to break the bone, although there be no resistance offered on the opposite side. The two following cases illustrate this kind of force.

Case.—Edward Godsell, æt. 10, Nov. 26, 1831, was admitted out-patient to the Middlesex Hospital. He stated that while playing with another boy he had a stone thrown at him, which struck him on the fore finger, his hand and arm being extended from the body at the time. On examination it was found that the phalanx adjoining the metacarpal bone was fractured. There was no appearance of any bruise or injury on the integuments.

Case.—Anne Jones, Nov. 3, 1835, was attempting to separate a man and his wife who were quarrelling, when she received a blow from a stick on the fore finger. She applied to the hospital shortly after the injury, when it was found that the first phalanx was fractured, no injury being done to the integuments around.

These two cases then, illustrate the kind of force that generally produces simple fracture of the finger. The phalanges, however, are sometimes but very rarely broken by the indirect force, for it is only under peculiar circumstances that such small bones can be brought under its influence; for it requires the bone to possess length of a certain extent before it can act, as will be exemplified in fractures of the femur, humerus, and other long bones. The following case, however, illustrates fracture of the phalanx of the thumb by the indirect force, where it will be seen that the force

was applied to the extremity of the bone, but the fracture took place in the centre.

Case.—Edwin Coleman, æt. 17, admitted at the Middlesex Hospital, October 16, 1835. Stated that he fell down while running, and caught his thumb between some iron railings, and gave it a sudden twist. He felt something snap, and, on looking at the part, found it out of shape, and, as he thought, dislocated. This, however, was not the case; but fracture had occurred at about the middle of the phalanx, adjoining the metacarpal bone. The integuments were uninjured.

In simple fracture of the fingers, the bone is seldom broken in more than one place, and generally near to the centre; while in the compound, the bone is most frequently comminuted into many pieces, and often extends into the adjacent joints.

The symptoms denoting fracture of the fingers are very easily discovered where it is compound, for the least motion in the part produces a crepitus and separation between the portions of bone, and so indicates the nature of the injury. But where the fracture is simple, the symptoms are not so marked, and a more minute examination is often required; for sometimes the fracture is so close to the joint, that it is difficult to move the fractured surfaces one upon the other so as to gain a crepitus, or a distinct motion between the two portions of bone; for the joint itself will yield, and give the idea of motion between the ends of the bone, when really none exists.

If the simple fracture be in the centre of the phalanx, the nature of the injury is easily discovered; for the portion of bone on either side of the fracture can be grasped, and motion be given to them, by elevating

one and depressing the other, and so producing a distinct crepitus. Sometimes the shape of the finger will indicate the nature of the injury; for there may be a depression in the situation of the fracture, caused by the ends of the bone being out of apposition.

All the phalanges are not equally liable to the simple fracture; for it will be found that the one adjoining the metacarpal bone is the most frequently fractured, owing to its greater length, and to its presenting a more fixed point, when any force tells upon it. The fore finger is more frequently fractured than any of the others; for it is more exposed to injury, both from its situation and from its being brought more into use. The phalanges of the thumb are comparatively seldom the seat of simple fracture; for a force, when applied to them, more frequently produces dislocation. The extreme phalanges can hardly be the seat of simple fracture; for they are so small, and their structure of such a nature, that a resisting force on the opposite side is required before they can be broken, and then the fracture, from the nature of the force applied, is generally compound.

TREATMENT OF COMPOUND FRACTURE OF THE FINGERS.

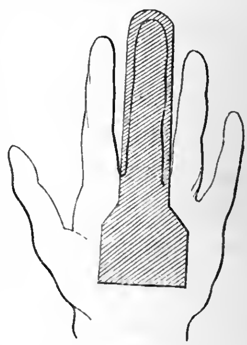
When the soft parts round the bone have been greatly bruised and torn, very little can be done with any apparatus in the shape of splints; for the pressure necessary to support them separately on the fingers themselves cannot be borne. The best treatment that can be adopted in these cases, is to lay the hand and fore arm on the common hand-board, which is made to the shape of the hand, and is slightly hollowed out

for the reception of the fingers, and long enough to extend up to the elbow. The whole hand and fore arm will be supported by this means, and the fingers steadied as well. The wood-cut represents the kind of splint.

There is no fear of lateral displacement occurring, for the adjoining fingers will serve as splints one to the other sufficiently, until the state of the soft parts will allow of their being dressed separately; when pressure can be made on each finger individually, and any displacement that might previously have existed can then be redressed. The advantage of employing the hand-board is, that the fingers, wrist joint, and the fore arm, are all steadied without making any pressure on the injured part; for the bandage need only tell round the back of the hand and wrist, and up the fore arm, and leave the fingers quite free from pressure; and the bandage does not require to be tightly applied, for the sling which must be employed will support the splint, and remove all necessity of confining the limb to it.

If it be merely the last phalanx, and of one finger only, that is fractured, it will then be necessary to confine the one finger, which may be done by means of a small lath splint, made in such a manner that as little pressure as possible need tell upon the fractured phalanx itself. This is done by making the part of the splint on which the finger rests of sufficient width to allow the finger to lie easily upon it, and hollowed out, or not, to make its position more steady. The

length of it should be such as to allow it to extend into the palm of the hand, nearly to the wrist. This part of the splint which occupies the palm of the hand, should be twice the width of the finger part, to allow of the bandage having a firmer hold, by which the splint will be more supported, and without the necessity of making much pressure on the finger itself. In the wood-cut the shape of the splint is shewn, and its application to the hand. It is fixed by means of a bandage passed round the hand and wrist, so as to include the broadest part of it. Very little pressure need be made on the finger itself; for if the palmar part of the splint be well fixed, there will be no disposition for the finger to move, and a few turns of bandage sufficient to confine the dressings will be all that is necessary.



The above-shaped splint is suited for the middle or ring finger, and when the fracture is in the fore or little finger, the same kind may be employed, only making the wide part of the splint extend on one side, towards the palm of the hand, according to the finger that happens to be the seat of the injury.

When the thumb is the seat of compound fracture, it is generally best at first to employ the hand-board, for the unequal shape of the part prevents the application of a single splint with any advantage when pressure cannot be made on the thumb itself. The hand-board will steady the part and confine the dressings; displacement may also be prevented by applying compasses between the thumb and fore

finger, and steadying them with the bandage that confines the whole hand.

In dressing compound fracture of the fingers, the injury is to be considered of the nature of other contused or lacerated wounds; taking care that no unequal force is made, by which the free escape of matter will be prevented, and mischief caused in parts of the hand remote from the injury. Poultices, fomentations, and leeches, must be applied according to the degree of inflammation present; when the parts are in a fit state to dress, it will be best to dress each finger separately (supposing more than one to be injured), for by so doing the wounds are kept more cleanly, and the soft parts round the bone are more supported, which will tend greatly to facilitate the healing process, and produce union at a much earlier period than otherwise would be the case. The proper time for dressing the fingers after a compound fracture, will be indicated by the appearance of the wound and the degree of pressure the patient can bear on the part.

In the compound fracture of the fingers, accompanied with much laceration, there is generally a great disposition in the integuments to fall from the bone; when this is the case, it must be prevented, by applying one or two strips of adhesive plaster round the part, taking care, however, not to make sufficient pressure to constrict one part of the finger more than another, and so produce inflammation and obstruction to the circulation. The hand and fore arm must be kept constantly supported in a sling, with the hand at a higher level than the elbow—the whole limb will thus be steadied and much pain prevented to the patient.

As compound fracture of the fingers is generally produced by an injury that at the same time causes great destruction to the soft parts, amputation becomes much oftener necessary in this than in any other kind of fracture. There are many cases where so much laceration and injury are done to the fingers, that the surgeon can have no hesitation with regard to the propriety of amputating immediately; but there are others, however, which at first sight appear to be so much injured, that very little hopes can be given of their ultimate recovery, which do, by great care and attention, get well, and restore to the patient a useful limb. In all these cases, however, the cure is very long and tedious; but still, if so important and useful a part as the finger can be saved, every opportunity should be taken of doing so. It becomes important then to have some guide by which a decision may be come to, as to the chance there may be of saving the part in some instances, while in other cases no such chance exists; and this guide I think may be got by attending to the kind of force that produced the fracture; for there are two ways in which the compound fracture may be produced, the one where the fingers are crushed by a heavy weight falling directly on them; the other where they are caught in machinery or fractured by a force that tears or lacerates the soft parts rather than crushes them: and these two kinds of forces, I think, make an important difference with regard to the chance there may be of preserving the finger, for when the parts are crushed as by a heavy weight falling on them, both the bone and soft parts have their vitality more destroyed than when they are torn or lacerated; for in the latter case there is not

the degree of bruising that there is in the former, and so much less likelihood of their vitality being destroyed. By the former kind of force also the bone is more comminuted than by the latter, which makes the injury of a more serious nature. The soft parts also slough and produce a much more formidable looking wound than appeared at first, and which would not be expected, except where the bruising or crushing kind of force has produced the injury.

One favorable circumstance in the compound fracture of the fingers, where it is confined to the phalanges only, is that the injury remains more local, and is less likely to spread up the hand and arm, than when the bones of the carpus or metacarpus are included in the injury; so that one urgent reason for immediately amputating in other kinds of compound fracture does not exist here, viz: the fear of the local inflammation spreading up the limb to an extent to produce that degree of constitutional disturbance that might endanger the patient's life. If then there appear to be a chance of preserving the finger, such chance should be given, for amputation can be performed afterwards should it be deemed necessary. I have seen many formidable looking cases of compound fracture of the fingers ultimately recover, of which very slight hopes were entertained at first, and these, I think, have generally been when the soft parts have been lacerated and not bruised.

TREATMENT OF SIMPLE FRACTURE OF THE FINGERS.

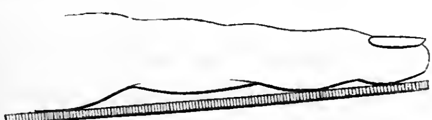
The causes which make compound fracture of the fingers of so serious a nature, namely, the crushing and bruising of the soft parts round the bone, are ab-

sent in the simple fracture, so that the injury is one of a much less serious nature, and more simple in its treatment: nevertheless, there is a good deal of nicety and care required, owing to the part itself being so small to which the splint and bandage have to be applied.

The kind of force that produces simple fracture of the finger is such as seldom to include more than one phalanx, and of one finger only: and the fore finger, as already stated, is most frequently the seat of the fracture; dependant, no doubt, on its situation and freer motion oftener exposing it to injury. The phalanges of the thumb are not so subject to simple fracture as the fingers, but when it does occur, their fracture differs in some respects, owing to the muscles that form the fleshy part of the thumb preventing the application of the splints with the same facility as when the fingers are the seat of the fracture.

The splint to be employed for the treatment of simple fracture of the finger may be made either of wood or pasteboard, and the former is the most convenient, for it gives more support to the part and can be more easily applied. The simple lath splint is all that is necessary in the generality of cases, made of sufficient length to extend into the palm of the hand: no additional width to this part is now necessary, as in the compound fracture; for the splint can be supported on the finger itself, the pressure of the bandage, if evenly applied, producing no mischief. The part of the splint on which the finger rests, should not be wider than the finger itself, otherwise the bandage will not tell equally round it, but press on the upper and under surface only, and not at all on the lateral parts, and will consequently not give the fractured portion support in these situations.

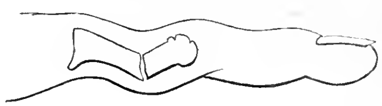
There is one point worthy of notice, where the fracture is in the phalanx adjoining the metacarpal bone, namely, that the round head of this latter bone, situated in the palm of the hand, forms a prominence that prevents the close adaptation of the splint to the part of the finger immediately beyond it; the consequence of which is, that a hollow is left, into which the fractured ends of the bone are depressed, when the bandage is applied, and an angle formed between them, and a permanent deformity in the shape of the finger, if union be allowed to take place with the bones in this position. This point can be easily seen by placing a lath splint under the finger, where no fracture exists, when it will be found that the part of the finger adjoining the metacarpal bone does not rest on it, but that a hollow is left in the situation of A, in the wood-cut.



A

This hollow is found to exist more in the fore and middle fingers than in the other two; for the heads of the metacarpal bones are larger, and consequently make a greater prominence in the palm of the hand, and a corresponding vacancy in that part of the finger immediately beyond it. This, however, can easily be remedied, by placing a small pad on the splint in this situation to fill up this hollow, which will then prevent the ends of the bone sinking from their proper level. The following case, out of many that I have seen, illustrates the want of attention to this point, and the consequent deformity arising from it. I have given a drawing which I made at the time from the man's finger.

Case.—Richard Matthews applied at the Middlesex Hospital, March 6th, 1831, with a bruise on the hand and other parts of the body. On examining the hand there was found to be a great deformity in the fore finger, in the phalanx adjoining the metacarpal bone. This was supposed to be caused by the recent injuries he had received, and to be fracture : he stated, however, that this was an old accident, and that he had his finger broken two years before by a heavy bar falling upon it. The bone is now firmly united, and presents the deformity, that is no doubt dependant on the want of support at the under part, in the situation of the hollow that I have just described, and which is represented in the wood-cut.



Some treat fracture of the phalanges by placing a small pad in the palm of the hand and then flex the fingers round it, and confine them in this situation; this may be useful in some cases, when there is much disposition for the flexor muscles to act, and produce displacement of the portions of bone; this, however, seldom happens, and the plan of treatment itself is not so good as the lath splint, for it does not keep the bone so steadily or so close in apposition. When the lath splint is employed, it requires great nicety to apply the bandage to so small a part so as to make it press evenly and firmly; it should not be more than an inch wide.

When the phalanges of the thumb are fractured, some difference is required in the application of the splints, for the unequal shape of the fleshy part of the

thumb, prevents any even support being given to its under or palmar surface, as in the fingers; the thumb also being separated from them, deprives it of any lateral support, and renders it necessary to apply all the support to the thumb itself, and in a particular manner owing to its unequal shape.

When the thumb is extended, its dorsal surface presents a very even line from the last phalanx to the base of the metacarpal bone, and it is upon this part that the splint must be applied, and the support be given to the fractured portions of bone; for a splint placed along the under surface could not make the same equal pressure, and would not lie in contact with it throughout its whole length. It will be found convenient to employ both pasteboard and lath splints for fracture of the thumb, and more particularly where the metacarpal bone is the seat of the fracture, for then the pasteboard can be moulded to the fleshy part (having been previously softened), and the lath splint be applied to the dorsal or external surface, so giving support to both sides. They may be applied as follows, a piece of thin pasteboard is to be well moistened in boiling water, and cut to the shape of the inner surface of the thumb, making the part that lies on the fleshy portion of it wider than the rest. The fractured portions of bone, whether it be the metacarpal or phalanx, are then to be fixed by an assistant, and to be kept in an extended position, so that all the bones may be in one line; a thin lath splint is then to be laid upon the dorsal surface, extending from the base of the metacarpal bone to the extremity of the phalanx, having a small pad of lint placed beneath it. An additional support will be given, by placing a triangular pad in the angle formed by the thumb and

fore finger, and confining it then by a few turns of bandage. The two splints are to be confined by a narrow bandage carried from the end of the thumb up round the hand and wrist, taking care to press firmly on the end of the splint near to the wrist, as upon this depends the straight position of it, and the proper extension of the fractured portions of bone.

The period requisite to confine the part in splints, when the bones of the finger or thumb are fractured, depends of course upon the fracture being simple or compound. When it is simple, three weeks will be long enough to keep the splint on, but the patient must not use the part for some time after; nor will he be inclined to do so, for his own feelings will indicate to him when the bone is strong enough to bear any weight or other kind of force applied to it. When the fracture is compound, there is the condition of the wound to consider as well as the injury to the bone; and, in the majority of cases, it will be found that the fracture unites sometime before the wound heals, rendering it necessary to keep the splint on for a much longer period than is actually requisite for the union of the bone.

The prognosis of fractures of the fingers will be favorable or unfavorable, according to the kind of force that has caused the injury; for, as before stated, if the part has been more bruised than lacerated, it will often require amputation ultimately, if not immediately at the time of the accident, owing to the vitality of the soft parts being so much destroyed, that sloughing takes place and leaves the bone exposed to a great extent; while if the integuments are only lacerated, and admit of being easily brought together so as to cover the bone, it will be right to give the part the chance

of recovering, and in many cases it will be found to do so.

The prognosis of the simple fracture of the finger may be said to be always favorable, for little or no inflammation follows, and there is no injury done to the soft parts around the bone. Many cases of compound fracture of the fingers terminate favorably, and afford the patient a useful finger, though perhaps not an ornamental one; for it is often found necessary to remove a small portion of bone at the time of the accident, or perhaps a piece exfoliates afterwards, and leaves the particular phalanx in which the fracture happens to be, shorter than natural, though it may still be a useful finger. Where the last phalanx is the seat of compound fracture, I should say that it will be always best to remove it at once; for so small a bone cannot be fractured but by a force that crushes it, and consequently leaves very little hopes of recovery, but will ultimately require removal, and the inflammation, perhaps may have spread to the adjoining phalanx, and require its removal also. Although as a general rule, the inflammation that attends compound fracture of the fingers does not extend to the carpus and fore arm, there are some cases in which it does, and in which suppuration and abscess form to a great extent up the limb, producing very troublesome, and often dangerous symptoms. It is generally found, however, that these patients are of a weak irritable habit, and among the class of the lower orders, who take large quantities of stimulating liquors, and get but little wholesome food; under these circumstances, they may be said to be predisposed to inflammation, with which they are attacked often from the most trifling causes.

An evil consequence that may arise after fracture of the fingers,when they have been confined for a great length of time in the extended position, as upon the hand-board, is a stiffness of the joints, which is often so great as to become a serious inconvenience, owing to the difficulty of curing it, and the length of time it keeps the patient before he can use his hand. This should always be borne in mind, when the fingers have to be kept extended for a great length of time, and it points out the necessity of not keeping them in this position longer than is absolutely requisite. The best remedy for this kind of stiffness, I believe to be, frequently soaking the hand in hot water, and then rubbing the fingers quite dry, and making passive motion in them, at the same time that the patient himself should try to move them. The fore arm should also be rubbed with some emollient liniment, for the muscles are as often at fault as the joints themselves.

FRACTURE OF THE METACARPAL BONES.

This kind of fracture is much more frequently simple than the fracture of the phalanges, for the bones are longer and more firmly articulated, which allows a force to tell upon them, which could not upon the fingers, owing to their want of resistance.

Compound fracture of the metacarpal bones generally occurs where a force is applied directly to the part, as a heavy weight falling upon them, or by their being crushed with machinery, &c. The injury is to be treated on general principles, considering it, more or less, as a common lacerated or contused wound. More inflammation may be expected in this injury than in compound fracture of the fingers; for

the bones here are in contact with parts that are more liable to inflame, and when such inflammation does arise, it is more difficult to check, depending on the fascia and quantity of cellular tissue situated in the palm of the hand, causing the formation of abscesses, which may burrow to a great extent. More vigorous means then must be taken to guard against this inflammation, by applying leeches frequently, and by making free openings for the escape of the matter, which will collect deep in the palm of the hand: by so doing, many bad symptoms will be prevented, and the cure be much facilitated.

The close connection of the metacarpal bones of the fingers, one with another, is such that little or no lateral displacement can take place; so that the mechanical treatment of this kind of fracture becomes comparatively simple. All that is necessary, or that can be done where the fracture is compound, is to lay the hand on the common hand-board, or upon a broad lath splint, with a small firm pad or cushion placed under the palm of the hand, to give support to the under surface of the bones; the dressings and bandage should be very lightly applied, and the fore arm and hand supported in a sling.

The simple fracture of the metacarpal bone is generally produced by the indirect force; as when any violence comes in contact with the end of the bone, it may then fracture in the centre. A person striking a blow with the fist against any hard substance often causes this bone to break. The two following cases illustrate the kind of force that produces it.

Case.—A. B. a coachman, was walking in the stable, when his foot caught against a stone, and he fell forwards with his arms extended, and struck

his middle finger against the post of one of the stalls with great violence; he felt something snap at the time and was unable to move his finger afterwards. He applied at the hospital on the following day, the hand was then greatly swollen, but a prominence could be distinctly felt in the situation of the middle metacarpal bone, and a crepitus when the ends of the bone were moved. This case is interesting from the force coming in contact with the end of the finger, and producing fracture of the metacarpal bone, rather than dislocation of one of the phalanges.

Case.—Richard Keeble, æt. 24, July 4, 1835.—A groom, was cleaning a horse, when the animal trod on his foot, and he struck it a hard blow with his fist upon the haunch bone. He immediately felt something snap; on examination, it was found that the metacarpal bone of the third finger was fractured, the digital portion being slightly depressed.

If the fracture be simple and confined to one metacarpal bone, the displacement that takes place is never very great, but is often quite sufficient to indicate that the bone is broken. This displacement is easily remedied, by placing the hand on a broad lath splint, with a compress opposite the depressed portion of bone, which is almost always the digital, for the carpal portion has little or no motion in it, owing to its articulation with the bones of the carpus. The apposition of the ends of the bone can often be got by placing a round compress in the palm of the hand, and then making the hand grasp it, and binding the fingers firmly to it; by this the end of the bone is pushed upwards from its depressed state.

The other symptoms of fracture of the metacarpal bone, viz. the motion and crepitus between the frac-

tured portions are often not present, owing to the difficulty of grasping them sufficiently in order to apply much force. This is more particularly the case, when the fracture is in the middle metacarpal bone, or in that of the fore finger. Attempts are to be made by grasping the carpal extremity with one hand, while with the other, motion is given to the digital portion of bone, by raising and depressing it alternately. If the crepitus can be got, and there be a prominence on the back of the hand at the same time, no doubt can exist as to the bone being fractured. When the metacarpal bone of the ring or little finger is the seat of injury, fracture may be supposed to exist when it really does not, for the articulation of these two bones with the carpus is much looser than the other two fingers, (which may be felt by examining ones own hand), this circumstance allows of considerable motion naturally, and may be mistaken for the motion depending on the fracture of the bone, more particularly when there is much swelling present to prevent a minute examination of the part. Motion alone then cannot be taken as a diagnostic symptom, without there be a crepitus accompanying it.

The treatment of fracture of the metacarpal bone I have already stated; namely, to place the hand on a broad lath splint, and if there be any disposition for the one portion to sink below the other, to place a firm compress in the palm of the hand, either laying the hand flat upon it, or else making the fingers grasp it firmly, and then binding them in this position.

The thumb presents some peculiarities in the fracture of its metacarpal bone, for it is unconnected with the other fingers, and consequently loses the lateral support which the other metacarpal bones

obtain. The symptoms of its fracture are more apparent, for the bone can be easily grasped and the two portions moved one upon another, and the crepitus be produced. The degree of displacement depends upon the kind of force applied. If the injury has been a very violent one, so as to tell upon the ends of the bone after the fracture is produced, they may be driven from their line of apposition, and cause a corresponding deformity in the line of the displacement.

The treatment differs from that of the other metacarpal bones, owing to the thumb requiring separate support, and the irregularity in its shape rendering it necessary to apply splints particularly to it, instead of laying the hand on one broad splint as in the other cases. A thin lath splint must be placed along the dorsal surface of the thumb, extending from the base of the metacarpal bone to the last phalanx, and another one against the palmar surface, the two should then be bound together by a narrow bandage passed round them, and round the wrist and hand.

The compound fracture of the metacarpal bones is to be treated on general principles, by dressing the part lightly and applying poultices, &c. according to the condition of the soft parts. The hand may be supported on the common hand-board or on a broad lath splint, taking care that it passes up beyond the wrist, by which the hand will be more steadied, and without the necessity of making much pressure upon the thumb itself.

FRACTURE OF THE BONES OF THE CARPUS.

The force requisite to fracture the carpal bones must always be directly applied, for their small size and their peculiar cancellated structure, will not allow the

indirect to act upon them. It is accordingly found that the injury is generally produced by a heavy weight falling upon the hand (a resistance being offered on the opposite side), as by a wheel passing over it, or by the hand being caught in machinery of some kind and crushed. When the nature of the injury is considered, and the kind of force that produces it, it will be expected that the soft parts around the bones will suffer, more or less, according to the extent of force applied ; and in the generality of cases great injury is done to them, and frequently to an extent to require amputation.

It sometimes happens that the carpal bones are fractured without any *appearance* of injury to the soft parts, and in these cases it is difficult to detect the fracture. This circumstance is more particularly met with in hard-working people, such as common labourers, in whom the integuments of the hand are so thick and hard, as to resist the pressure sufficiently in some cases, to prevent any wound being produced. The after-consequences, however, soon shew the extent of mischief done, when inflammation arises, accompanied by great swelling, and often sloughing of the integuments, &c., making the injury one of a most serious nature ; for the matter collects beneath the strong fascia of the hand, and causes the inflammation to spread up the arm, producing most severe constitutional disturbance.

Sometimes, when the carpal bones are fractured, a portion of one, or a whole bone, becomes displaced, and forms an unnatural prominence. When this is met with, attempts should be made to replace it, though it is very seldom that such attempts will succeed, without the displacement be only partial, and

then it is often unnecessary or impossible to do so. If the bone be completely pushed from its place, so as to cause a prominence that will be inconvenient to the patient, it should be removed, by making an incision through the integuments on the back of the hand, and taking it out. Some of the carpal bones, however, are naturally more prominent than others, and the bases of the metacarpal bones project slightly on the back of the hand as well, which should be remembered in examining this kind of injury; as displacement otherwise might be supposed to exist where really none does.

With regard to replacing the projecting portion of bone where it is met with, very little can be done; for if the displacement be great, it is next to impossible to force it back, without producing more serious mischief than the bone itself will cause if left; and when the displacement is only slight, the best treatment is to let it remain, for little or no harm will come from it. If the fracture be compound, so as to expose the displaced portion of bone, the best plan will be to remove it at once. In the majority of cases, however, this displacement is not met with; for the bones generally are crushed, and the soft parts with them, to so great an extent, that it much oftener becomes a question as to the propriety of amputating the whole hand, than of removing a portion of bone only.

The treatment of fractures of the bones of the carpus, when it is thought advisable to try and save the hand, is to be conducted on very general principles. Nothing is to be gained by splints, more than supporting the part on the common hand-board. When the injury has been very extensive, the patient had better remain in bed for some days, until the violence of the inflam-

mation has subsided. The arm should be raised upon a pillow, so that the elbow may be nearly or quite upon a level with the shoulder, and the fore arm and hand at a higher level still. This position will give the patient ease, and will retard the flow of blood to the part, and facilitate its return from it. Small pads of lint or tow should be placed under the palm of the hand, to fill up the hollow that naturally exists there, and to give more support to the injured bones. The part should at first be very lightly dressed, and cold lotion be kept constantly applied for two or three days; when the inflammation arises, it must be discontinued, and leeches, fomentations, or poultices must be applied in its stead, and kept on as long as the nature of the wound requires their use. In fractures of the carpal bones, it is requisite to attend to the constitutional symptoms as well as the local ones; for in this kind of injury the system sympathizes more with the part affected, than it does in fractures of the phalanges or of the metacarpus;—the consequence of which is, that the more active fever often accompanies it, producing great disturbance to the system generally, and requiring the most active remedies to subdue it. The local inflammation also spreads up the fore arm and arm, producing great mischief in all the textures it attacks. In these cases the greatest care must be taken to allow the matter to have free escape which generally forms deep in the palm of the hand beneath the fascia. General blood-letting may be employed, when the strength of the patient and the nature of the injury render it necessary. In the lower classes these cases bear very little depletion.

In this kind of injury it is of great importance to attend to the nature of the accident that caused the

fracture; for by so doing, the chances of saving the hand or not will be found to be great or small. When it is found that the force that produced the injury crushed and bruised the soft parts rather than lacerated and tore them, and this to a very great extent, very little hope can be given of saving the hand; for the inflammation that must now necessarily follow, produces effects that render amputation ultimately necessary; and often then at the risk of the patient's life, owing to the delay, and the consequent disturbance to the system, generally, that has been excited. When the injury has been caused by a force that produces laceration rather than bruising, there will be more hope of saving the hand; for the vitality of the soft parts has not been so much destroyed, nor the bones themselves so much injured, as in the former case. Tetanus sometimes comes on after these cases of fracture of the carpal bones, but it cannot be foreseen; and the *possibility* of its occurrence is not a sufficient reason for amputating a limb that otherwise offers every chance of recovery.

FRACTURES OF THE FORE ARM.

The bones of the fore arm are more frequently fractured than other bones in the body, owing to their length and mode of articulation with the hand, and their frequent exposure to injury. There are many points of importance to be considered with regard to their fracture: for the peculiar motion which the radius performs upon the ulna, renders it necessary to take particular care that the two portions of bone unite together in the same relative position of supination or pronation; otherwise their range of action will be impeded, and the hand will be deprived of its natural free motion that it possesses when no fracture exists.

Fractures of the fore arm are more frequently simple than compound; for the length of the bones enables a force to tell easily upon them, and without extending with any violence to the soft parts around. It is on this account that many cases of fracture of the fore arm are met with, where little swelling or apparent injury accompanies them. There is a difference in the comparative frequency of the fracture of the two bones; for it is found that the radius is more frequently broken singly, than both bones together, and that both bones are oftener broken, than the ulna singly: the difference may be seen by referring to the table at page 18. The reason why the radius is so often fractured, depends upon its mode of articulation with the hand; for the broad end of the bone receives all the shock when a

person falls, and enables the indirect force to act upon it; and its great length and shape allows the direct force to tell upon it very easily, when applied with any violence. The most frequent cause of the fracture is by the person falling on the palm of the hand, the arms being extended before or behind the body. It sometimes, but very rarely happens, that a fall on the back of the hand produces a fracture of the lower end of the radius. I have seen two or three cases of this kind. It is seldom, however, that the hand is placed in this position during falls; and when it is, the end of the bone does not immediately receive the shock as it does in falls on the palm of the hand.

The situation of the fracture in these, as in other bones, depends upon the kind of force, and the direction in which it is applied. The direct force causes the bones to break at the point struck, while the indirect tells on a part of the bone some distance from the end of it which receives the shock; as when a person falls, and comes upon the hands, the end of the radius receives the shock, but the shaft of the bone will very likely break. The most common situation for the fracture to occur in, is at the centre, or within the lower third of the bone; the upper third is seldom acted upon. The different angle the bone may be in with regard to the ground on which the hand falls, will produce a difference in the situation of the fracture; for in those cases where the arm is more extended from the body, the bones are more obliquely placed, and the central part will be more likely to be acted on by the shock, than the extremity of the bone, which requires the force to tell vertically through it. The difference in the angle of the limb with the ground, when the shock is received, I think, will explain the reason

why some fractures are nearer to the wrist than others, and why some are quite in the centre of the bone. The bones of the fore arm are seldom broken in their upper third but by the direct force; and the force must be of a very violent kind to tell upon them both at once in this situation, owing to the thick covering of muscle that protects them, and deadens the blow.

The direction of the fracture is generally transverse, owing to the circular shape of the bones, except at the upper part of the ulna, which is triangular, and here it may be oblique; for the shape of this part of the bone will offer different degrees of resistance to the force as it passes through it, and so cause it to take a different direction.

The symptoms of fracture of the fore arm are generally very apparent, and are more or less so according to the situation of the fracture; for when it is near to the joint, it will be found much more difficult to discover the nature of the injury, than when it is nearer to the centre of the bones; for when in the latter situation, there is more displacement of the ends of the bone, and more deformity in the shape of the limb, there is also freer motion between the fractured portions, and a greater facility of producing the crepitus; while in the fracture near to the wrist joint, the portions of bone articulated with the carpus are so small, that they are with difficulty grasped with sufficient firmness to move them upon the upper portions, so that the above symptoms are not easily produced. Another reason is, that the ends of the radius present a broader surface when the fracture is near to the wrist, which preserves their apposition better, and renders it difficult to produce motion between them.

An important point to be attended to, when the

fracture is near to the wrist, is not to mistake the injury for a dislocation; a mistake that might occur without a careful examination of the part being made; the points of distinction I shall describe under the head of fractures of the radius singly, as the peculiar deformity exists more with it, than with the fracture of both bones. The following are the symptoms to be looked for in fractures of both bones, some of them however, are often more apparent than others, depending on the extent and kind of force applied. Displacement of the ends of the bone, producing a corresponding deformity in the shape of the limb; which is often so great as to indicate at once the nature of the injury. The displacement is greater in fractures towards the centre of the bones, than when near to the wrist, for reasons already given. It may take place in the longitudinal or transverse directions, or in both. In the first, the fore arm will be shorter than natural, and thicker from the anterior to the posterior surface. In the second, it will be wider than natural, and need be but little shortened; in general one portion of bone is found in the interosseous space while the other is lying to the side of it, being on the outer side of the radius or the ulna, according to the direction of the displacement. In the third direction, there is both shortening of the limb and increased width of it; for the portions of bone are drawn upwards as well as displaced laterally. Complete lateral displacement of both portions of bone to the outer or inner side of the fore arm must be very rare, it generally happens that one portion stops in the interosseous space.

The immediate cause of the displacement in the majority of cases, is the force that produces the frac-

ture, which at the same time that it breaks the bones, drives their ends from their natural apposition. The muscles I think have not so much influence in causing the lateral or longitudinal displacement, as is generally attributed to them, and more particularly the longitudinal, for without the displacement be complete no retraction can take place. They have an influence over the portions of the radius singly, which will be considered when speaking of the treatment. The weight of the hand tends in many cases to cause displacement, by depressing the lower portions of bone, or by bringing the radius too much into pronation.

The crepitus, or grating of the fractured surfaces upon one another, is easily produced when the injury is situated in the shaft of the bones, for then the portions of bone admit of being moved, and can be rubbed the one upon the other; but the nearer the fracture is to the wrist, the more difficult is the crepitus to produce, owing to the greater difficulty of moving the fractured surfaces against one another. The mode of producing the crepitus, is to fix the upper part of the fore arm and to rotate the lower upon it, by alternately supinating and pronating the hand.

When the fracture is near to the wrist, there may be effusion of fluid into the sheaths of the tendons or into the joint, which will give the sensation of a crepitus when pressure is made upon it, which pressure cannot be avoided during the examination of the joint, owing to the lower portion of bone being so small that has to be grasped. This sensation is also more evident when there is much swelling present; it is, however, distinct from the crepitus produced by the fractured surfaces rubbing upon one another, and will not be

mistaken in a careful examination of the part. A simple sprain may be accompanied with this effusion of fluid into the neighbouring textures of the joint, and will give the sensation of crepitus of a fracture to one inexperienced in examining these kinds of injury, when really no fracture exists. When the fracture is towards the centre of the bone, and the crepitus cannot be produced by rotating the portions of bone upon one another, it often may be by pressing upon them laterally so as to push them towards the interosseous space, by which the fractured surfaces will be likely to move from their apposition, and to grate upon one another.

Extreme pronation of the hand with inability to supinate it, may be taken in many cases as a diagnostic symptom of the radius being fractured; for the weight of the hand may be sufficient to draw the lower portion of bone with it, without the upper portion following; a corresponding deformity will then be seen, and the fore arm will have the appearance of being twisted. This position often produces so much pain, that the patient is found supporting the limb with the opposite hand, not being able to bear the weight of it without this aid, before the bones are reduced and put into splints.

In reducing fractures of both bones of the fore arm, where much displacement exists, the force must be applied in two directions, namely, by extending and rotating the limb. This is to be done as follows:—the elbow should be flexed in order to relax the muscles, and the upper part of the fore arm grasped so as to fix the portions of bone connected with it. Extension is then to be made, by taking hold of the hand and wrist and pulling the lower portions of bone forcibly,

but gradually, down from the elbow; by which any riding of the ends of the bone will be reduced, and the proper length of the fore arm be obtained. After the extension has been made, the hand should be brought into supination, by turning the lower portion of the fore arm in this direction as much as possible, by which the ends of the bone will often be unlocked when no other position will do so; and the lower portion of the radius will be brought out of the state of pronation that it has a disposition to fall into after being fractured. The extension is best made by grasping the palm of the hand and wrist joint, so as to include the lower ends of the bones as well: some, however, recommend the fingers alone to be grasped, as giving more purchase upon the lower portions of bone. Desault recommends this plan: "an assistant makes extension by grasping the four fingers, which answers better than the method given by Petit, of pulling upon the wrist, since the force of a power is in the inverse ratio to its distance from the resistance." There are two reasons, however, for objecting to this method; one is, that the portions of bone are less easily fixed when the fingers only are taken hold of; the other is, that the force tells much less upon the fractured ends, having to pull upon so many joints before it reaches them.

TREATMENT OF FRACTURES OF THE FORE ARM.

The peculiar motion which the radius performs upon the ulna, renders it of the utmost importance that the two portions of bone should unite in their natural relative position as much as possible, if the perfect range of the one bone upon the other is to be preserved after union has taken place. The point to be considered

then is—what treatment is most likely to bring the upper and lower portions of the radius into that position in which they will be in the same relation, with regard to pronation and supination, as they are in their natural or unfractured state; for it is quite obvious, that as this motion depends altogether upon the upper end of the radius turning upon the ulna and outer condyle of the humerus, the lower end must be placed in the same relative position with it, if the hand is expected to have the same range of action that it possessed before the fracture. But this is a difficult point to decide; for the upper portion of the radius turning upon its long axis, and being so thickly covered with muscles, renders its position, with regard to the degree of supination it may happen to be in, not always easy to ascertain. This is a difficulty which does not exist in fractures of the other bones; for, in them, the relative position of the joints, or of the ends of the bone connected with them, is always a guide as to the position of the fractured ends; but in that of the radius, the shape of the limb may appear natural, although the ends of the bone are not in correct apposition, for the upper portion may be in a different state of supination to the lower, and yet the wrist and elbow joints may appear to bear their natural relation to one another, and the limb to be of its natural shape. On this account then, the absence of deformity in the shape of the limb, cannot be taken as an indication of the proper apposition of the fractured ends of the radius, though it may with regard to fractures of the ulna.

The ordinary position by which fractures of the fore arm are treated, presumes that the upper portion of the radius is always so nicely balanced between pronation and supination, that when the hand is placed

midway between these two positions with the palm turned towards the chest, the lower portion of bone is then brought into the same state, and so bears the same relative position to it that it did before being fractured.

After I had opportunities of seeing many cases of fractures of the fore arm, it appeared to me that the position so generally recommended and adopted, presumed too much upon the upper portion of the radius always being so placed that it should correspond exactly with the lower, when the fore arm and hand are placed midway between supination and pronation with the palm towards the chest, and consequently that this position was not founded on the truest principle, nor the one the most likely to prevent deformity in the limb, but that a better one might be adopted, and one that would guard against the imperfect supination that so often exists after this kind of fracture.

I think that the position of the upper portion of the radius has not been sufficiently attended to in the treatment of fractures of the fore arm; and that it is often in a different degree of supination with the lower, which being overlooked, and union being allowed to take place, causes the want of perfect supination that so often remains. Could it be depended upon as a certainty that the radius should always be so fractured, and in such a direction, that the two portions were locked within one another, and that the upper portion remained stationary to allow of the lower being brought to it (which the ordinary position presumes), there would be no fear of displacement; and very little necessity for guarding against it. But as this cannot be depended on, and as it does often happen that the

ends of the bone are not locked together, and that one portion moves without the other, there must often be a difference in the relative degrees of supination of the two portions. It will be necessary, then, to endeavour to find out the position that guards against this, and to place the limb so as to bring the portions of the radius into the same degree of supination as much as possible. How far the position of midway between pronation and supination obtains this object, I shall endeavour to decide. When the ordinary position is employed, by placing the palm of the hand towards the chest, the lower end of the radius must always be midway between pronation and supination; for it is so firmly articulated with the wrist, that the one cannot move without the other. But, can the upper portion of the radius be always depended upon as agreeing with it? I think not: for to assert that it is so placed, is presuming that it was in this position of midway between pronation and supination at the time it was fractured, and that it has not moved since; or else that the muscles inserted into it have acted to so great a nicety, that the upper portion of the radius is brought exactly midway between the two positions, so as to allow of the lower portion accommodating itself to it, when the palm of the hand is placed towards the chest. To presume thus much, is to say that the muscles are to be depended on as acting only in one direction, and only to a determined extent; or else that the bone is always in a state midway between pronation and supination, and does not move from this position after the fracture has taken place.

To determine the probable position of the upper portion of bone, the muscles connected with it must be well considered, and their action known. The

muscles that turn the radius upon the ulna are of two classes, namely pronators and supinators, which act by some of them being inserted directly into the radius itself, while others are inserted into the hand, and act through it and the wrist joint upon the fore arm. Those that act directly upon the radius, are the only ones that have an influence over the upper portion of bone when fracture exists; for those which act upon the hand and lower portion, are then isolated and separated from it altogether. The muscles inserted directly into the radius, and which have an influence over the upper portion of bone are three, namely, the biceps flexor cubiti, the supinator radii brevis, and the pronator radii teres: the two former having the power of supinating the upper portion of the radius—the latter one of pronating it. It remains to be seen, then, which of these muscles will be most likely to act when fracture exists, and into what position they will be most likely to bring the upper portion of bone.

The usual position in which the fractured fore arm is placed as already stated, presumes that these three muscles act to so great a nicety, that this upper part of the radius is always placed exactly midway between pronation and supination, that is to say, the pronator radii teres opposes the action of the biceps flexor cubiti, and supinator brevis; the usual position certainly presumes this, otherwise the lower portion of bone could not be supposed to correspond with it, when the palm of the hand is turned towards the chest. If, however, the pronator radii teres be allowed to act, why should it do so to so great a nicety as to bring the upper portion of the radius just midway and no further? It is quite possible if it act at all, that it will as often pronate it too much, as pronate it

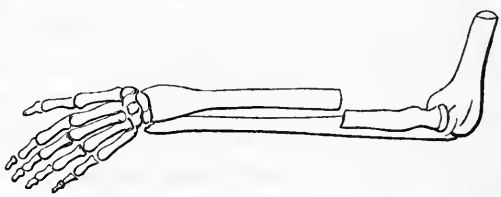
just enough to accommodate itself to the position in which the lower portion is placed. If this muscle be allowed to act in some cases, and so bring the portion of bone into which it is inserted into a state of pronation, may not, for the same reason, the supinators be disposed to act, and so tend to bring it into a state of supination? And if it is found that the supinator muscles are more powerful, and that from peculiar circumstances they are more disposed to act, are not the probabilities greater, that the portion of bone into which they are inserted, will be more frequently brought into supination than into pronation?

The muscle that immediately counteracts the action of the pronator teres is the supinator radii brevis, but allowing it less power than the pronator, and that there will be more tendency for this muscle to act than the supinator, it will not often do so; for the biceps flexor cubiti is more powerful still, and can easily oppose the action of the pronator, and always have a tendency to bring the bone towards supination; for this muscle is a most powerful supinator, and it is very difficult to prevent it acting, and more particularly when any injury exists in the fore arm, for then the instinctive effort of the patient to support the limb, brings this muscle into play, and will easily, when the bone is broken, move the upper portion of the radius with it into a state of supination; for it has to be remembered, that all those muscles that tend to counteract the action of the biceps in the sound state of the limb are now removed, namely, the pronators that pass from the inner condyle of the humerus down to the wrist and hand: for the radius being fractured, isolates their action completely, and destroys their power of moving the upper portion of the bone.

If, then, the biceps be allowed to act, must not the upper portion of bone be often brought into a state of supination?—and will not this explain why it is found, that when the ordinary position of treating fractures of the fore arm is employed, there so often remains a difficulty of producing perfect supination after the bones have united?—which evil, I think, remains more frequently than is supposed after fractures of the radius; and that it is often overlooked, and fancied not to exist, from want of attention to the following point. When the surgeon wishes to satisfy himself, after fracture of the radius, that the bone retains its free motion upon the ulna, he tells the patient to try and supinate the hand to the utmost, and apparently he seems to have the power of doing so, when in the majority of cases it will be found that in reality he has not; for on close examination it will be seen, that the hand is only capable of being supinated to a certain extent, and that the deficient range of action is compensated for by rotating the humerus, and so bringing the elbow before the chest; for the humerus cannot be rotated outwards, without bringing the fore arm into a state of supination at the same time. This fact, no doubt, often deceives the surgeon, and leads him to think that the radius has its free motion, when, in reality, the major part of it is produced by the humerus turning in the glenoid cavity of the scapula. My attention was first directed to this point, from seeing many cases of fractures of the radius, where, after union, the hand could not be perfectly supinated; and finding this evil to be of so frequent occurrence, I was led to consider the reason of it; when it appeared to me to depend upon the upper portion of the bone generally being in a greater state of supination than the lower; and that if such was the case, the position or-

dinarily recommended was not the one most likely to prevent the evil, and consequently not the one that ought to be employed.

The position of the two portions of the fractured radius in which the ordinary treatment places them, is, that of bringing the lower portion midway between pronation and supination, by turning the palm of the hand towards the chest; while the upper portion remains in a position more towards supination, owing to the action of the biceps flexor cubiti bringing it there, though it may act but very slightly. The annexed wood-cut shews the position of the two portions of bone, which is rather exaggerated to explain more clearly my meaning.



Now it is quite obvious, that if the two portions of bone be allowed to unite in this position, the motion of supination cannot be performed; for the portion of bone on which this motion depends, namely, the upper portion of the radius, is already partially or completely supinated.

Although I have stated so much with regard to the action of the biceps muscle, and the position of the upper portion of the radius, I am aware that there are many cases in which the ordinary treatment leaves no deformity in the limb, and where the motion of the one bone upon the other remains perfect. This will always be the case where the fracture takes such a direction that the ends of the radius remain locked against one another; and so move together in what-

ever position the hand is placed, and always preserve the same degree of pronation and supination. There are cases, however, and I believe them to be numerous, in which the above deformity does exist, and where the motion of supination remains imperfect, owing to the above position of the limb being adopted. When the fracture is above the insertion of the pronator radii teres, the upper portion of the radius will be almost always supinated, for the biceps and supinator brevis have no antagonist to oppose their action.

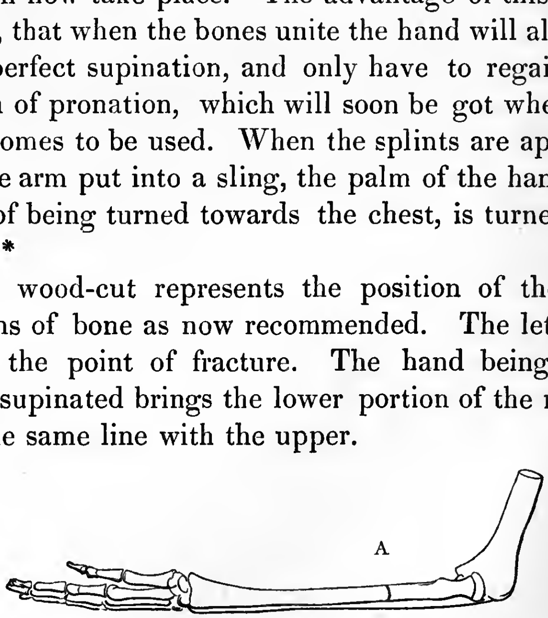
In the majority of cases the evil only exists to a small extent, and these are the instances in which it is so often overlooked; for the position of extreme supination is so seldom called for in the ordinary occupations of the hand, that if the defect be only slight, it will not be perceived. But there are cases where the two portions of bone have united in such opposite states of supination, that not only is the free motion of the radius upon the ulna impeded, but actual deformity exists in the limb. I have seen more than one case of this kind, and where it was evidently dependant on the lower portion of the bone; being in a different state of supination with the upper.

Having asserted that the ordinary position for treating this kind of fracture, is one likely to impede the future supination of the fore arm in many cases to a marked extent, and in the majority to a small one; and having offered the position in which the upper portion of the radius remains, as an explanation of the evil, the treatment to be adopted in order to guard against it becomes obvious; namely, to place the hand and fore arm in such a position, that the lower portion of bone may be supinated to the same extent as the upper; and this is done by supinating the hand to a

much greater extent than the position of midway between supination and pronation admits of.

Before applying the splints, let the hand be brought into the utmost state of supination; and, while in this position, lay it on a splint about the width of the fore arm, extending underneath from the back of the hand up to the elbow; then fix it to the splint in this position, with a bandage carried from the fingers upwards. Still keeping the hand supinated, let another splint be applied, extending from the palm of the hand, or fingers, up to the bend of the elbow, and broad enough to press on the fleshy part of the thumb, as it will then prevent any tendency to pronation. Another bandage should then be firmly applied over both splints; so keeping the fore arm completely supinated between them. If the splints are well fixed at the hand and elbow, no pronation can now take place. The advantage of this position is, that when the bones unite the hand will already be in perfect supination, and only have to regain the motion of pronation, which will soon be got when the hand comes to be used. When the splints are applied, and the arm put into a sling, the palm of the hand, instead of being turned towards the chest, is turned upwards. *

The wood-cut represents the position of the two portions of bone as now recommended. The letter A shews the point of fracture. The hand being perfectly supinated brings the lower portion of the radius into the same line with the upper.



* Vide London Medical Gazette, vol. ix.—1832.

The many cases of fractures of the fore arm that I have treated and seen treated by this position, have all completely recovered the power of supinating and pronating the hand to the utmost;—shewing, that if it does not possess greater advantages than the ordinary treatment, it possesses equally as great. But I am convinced that in the generality of cases it will be found to prevent the deformity above mentioned, which does and will often occur where the position of midway between pronation and supination is employed.

Another point worthy of consideration is, whether the position now recommended does not obviate another evil, namely, the falling of the fractured ends into the interosseous space. For when the hand is completely supinated and supported on the back splint, all the weight of the hand is taken off the ends of the bone, and the very act of bringing them into extreme supination tends to draw them out, and to lock them in the upper portions of bone.

To counteract this approximation of the ends of the bone, it is recommended by some to apply compresses on the fore and back part of the limb, so as to press the muscle between the bones, and to keep them apart. This, however, can be also done much better when the fore arm is in the state of extreme supination, than when it is placed in the ordinary position. Petit, Duverney, and Desault, were strong advocates for the employment of these compresses, and Boyer says that they are "one of the most essential parts of the apparatus." They are recommended, in order to oppose the action of the pronator radii teres, and the pronator quadratus, which muscles tend to pull the radius inwards towards the ulna, when it is broken,

and the pronator quadratus will have an action upon the ulna as well, when both bones are fractured. I am inclined to think, that very little advantage is gained by these compresses, and that the pressure of the muscles into the interosseous space has not much effect upon the portions of bone themselves, more particularly those on the anterior part of the fore arm, for the interosseous membrane in this situation takes hold so near to the surface of the bone, that there is nothing for the muscles to press against laterally, and consequently they can have no effect upon the portions of bone, except that of rather approximating them, by pushing the membrane backwards. The posterior muscles will have more effect, but still very little, for here there is very little projecting surface for them to press against laterally; to allow of the muscles acting in this way at all however, the compresses must be pressed upon by two broad lath splints, placed one on the fore part, the other on the back part of the limb. The splints must extend beyond the edge of the fore arm, in order to take off the lateral pressure of the bandage, which otherwise would tend more to approximate the portions of bone, than the compresses could separate them.

The position of placing the fore arm midway between pronation and supination, gives the bones a twist upon one another, by making the radius cross obliquely over the ulna. This twist in the shape of the limb is often exemplified, where a thin broad splint is made use of during the treatment, for if the splint be made to lie flat on the fore arm, both at the elbow and wrist joints, it must take a twist in the centre, when the palm of the hand is placed towards the chest.

This twist is represented in the wood-cut: A shows the part of the splint that rests against the palm of the hand, B the part that rests against the elbow.

The upper portions of the radius and ulna have little disposition to fall into the interosseous space, for the ulna being locked into the groove of the condyles, cannot move laterally, and the radius can do so but very slightly, owing to the orbicular ligament bracing it up firmly against the condyle also. The lower portions, as already stated, have no disposition to become approximated, when the position of extreme supination is employed, for then the weight of the hand is taken off them, and they are not acted upon by it, as is the case when the ordinary position is made use of; for then the least dropping of the hand tilts up the portion of the ulna connected with it, and if it be too much elevated, the end of the radius will be pushed inwards, and produce the opposite deformity. It is on this account that it becomes necessary, when the position of midway between pronation and supination is employed, to apply a splint along the radial and ulnar side of the fore arm. The object of the former is to depress the hand, and to draw out the lower portion of the radius from the interosseous space; that of the latter is to prevent the bandage pressing upon the lower portion of the ulna, and so displacing it inwards. The latter splint should only extend to the wrist, and not beyond it, otherwise the effect of the one on the radial side will be counteracted. I do not think, however, that this radial splint has much effect, for the hand naturally admits of so much adduction, that the ligaments cannot be put suf-

ficiently upon the stretch to tell with any force upon the bone. This point, however, will be more considered when speaking of fractures of the radius singly.

The cause of this approximation of the two lower portions of bone, is generally ascribed to the action of the pronator quadratus. This may be the case where the fracture is towards the centre of the bones, for then the surfaces of bone are so small, that they admit of being easily unlocked, where the direction of the fracture is transverse, or where it is comminuted; but in fractures near to the wrist, the surfaces of the radius are so broad and rough, that I conceive it next to impossible that so small a muscle can move the portions of bone from their apposition; it may, however, act upon the lower portion of the ulna, if it acts at all, and pull it inwards. The chief cause of displacement in fractures of the radius near to the wrist, no doubt is the force that produces the fracture, which drives one portion beyond the other after it has broken the bone.

When the splints are applied, the hand and fore arm should be supported in a sling, from the elbow to the fingers. If the position of midway between pronation and supination be employed, the limb should be kept close to the chest; if that of extreme supination, the elbow should be kept by the side, and the hand be allowed to fall forwards. Sometimes the bones of the fore arm are fractured in more places than one, when a very heavy weight comes upon them. Desault mentions the case of a woman who had the fore arm broken in six places, by a cart-wheel passing over it. These cases are generally compound, owing to the kind of force that produces the fracture: the injury of the soft parts must be attended to as well as that of the bone,

by applying poultices, &c., according to the state of the wound. The limb must be supported on a broad splint placed on its posterior surface, and care taken to avoid all lateral pressure; the position of extreme supination is the best that can be employed, as it then removes all the weight of the hand from the portions of bone. In these cases, it sometimes happens that the free motion of the radius upon the ulna is lost, owing to the fractured portions of the two opposite bones becoming united together, by the callus that forms around them. When the soft parts are greatly injured, and it is still deemed advisable to try and save the limb, the patient had better remain in bed for a few days, until the local inflammation has subsided, and the wound recovered sufficiently to allow of it being dressed. For the after-treatment, the chief object to have in view, is to guard against the too early use of the limb; for in this fracture, more than in any other, there is the fear of a false joint being formed, owing to the peculiar motion of the radius upon the ulna. The period at which the splints may be discontinued, will depend upon the age and constitution of the patient; as a general rule, from four to five weeks will be sufficient to keep the limb confined. In children, union takes place much sooner; three weeks, in most cases, being a sufficient time to keep the splints applied. The limb, however, must not be used directly the support is removed from the bones, but must be still confined in a sling, and passive motion only be given to it at first. The lifting of heavy weights, or pressing upon the palm of the hand, must be carefully avoided till the bones have recovered their strength.

During the period that the splints are employed, it will be necessary to remove them occasionally to see

that the pressure is made equally throughout the limb, and that the bandages do not cut the skin. Œdema of the fingers must be avoided, by commencing the bandage at their extremities, and passing it from them up the fore arm. By paying attention to the first bandaging, a great deal of unnecessary trouble will be saved, and the portions of bone need not be disturbed 'till some time after, which they must be at a very early period if they get loose, or constrict one part of the limb more than another.

FRACTURES OF THE RADIUS SINGLY.

Many of the points connected with this kind of injury have already been considered under the head of fractures of both bones; for it will be found that there is little difference in the treatment to be employed when the radius alone is fractured, to when the ulna is broken with it.

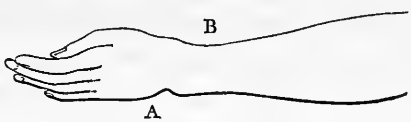
The radius is much oftener fractured by itself than in conjunction with the ulna, for the lower end of it forms so large a portion of the wrist joint, that it alone receives all the shock that is applied to it when a person falls upon the palm of the hand. The constant employment of the upper extremities exposes the bones of the fore arm often to injury, and the radius more particularly, causing its fracture to be more frequent than that of any other bone in the body.

The most common cause of fracture of the radius, is a fall upon the palm of the hand. It is sometimes broken by the direct force, but more frequently by the former kind, which tells indirectly through the shaft of the bone, the shock being received upon its broad lower extremity. The situation of the fracture may be

in any part of the bone, but it is found most frequently to occur in the middle or within the lower half of it. When it is broken within its upper half, the injury is generally produced by the direct force, for the length seldom allows the indirect to tell so high up, but causes the bone to break before it reaches this part. Fracture of the neck of the radius alone is a very rare accident, for this portion of the bone is thickly covered with muscles, and is so situated as to be little under the influence of either the direct or indirect force. Sir A. Cooper says, "This fracture I have heard mentioned by surgeons as being of frequent occurrence, but there must be some mistake in the statement, for it is an accident that I have never seen, and if instances ever present themselves (which I do not mean to deny) they must be very rare." It no doubt may be fractured in conjunction with other parts of the bone, when the fore arm is crushed by a heavy weight falling upon it, or by being caught in machinery, &c.; but for the neck of the bone to be broken alone, must be a very rare accident indeed.

The direction of the fracture through the radius, is generally transverse or slightly oblique; it may extend, however, in many directions, and separate the bone into different pieces, when the force has been directly applied, and of a very violent kind; under these circumstances the fracture is generally compound as well. It sometimes takes a longitudinal direction; a case of this kind is mentioned by Dr. Hughes, in the 13th vol. of the Medical Gazette,—It is a very rare accident. The lower end of the bone may be split up vertically, or into many pieces; this generally happens when a person falls from a great height, with the radius perpendicularly placed. I lately saw a case of

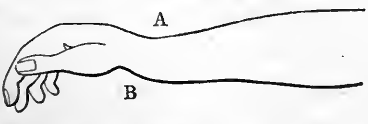
this kind, where a man fell from a scaffold, and died of other injuries he received. On examining the wrist joint, the lower end of the radius was found to be split upwards in two places, so as to separate the outer and inner edges from the shaft of the bone. In old people the radius is very often broken within the lower inch of the bone, just above the wrist, causing a depression to exist at the point fractured, and a prominence of the ulna on the opposite side; the hand is also generally turned more towards pronation than supination. The prominent ulna I believe to be a most characteristic symptom when present, of this fracture of the lower extremity of the radius: it is dependant on the hand being brought into a state of abduction, owing to the lower portion of the radius that is connected with the carpus being displaced inwards, which position then tilts the hand outwards, and so causes the lower end of the ulna to project. The wood-cut represents the appearance of the part: B the depressed portion of the radius, A the prominent ulna.



The ulna is sometimes so prominent in these cases that it may be said to be dislocated, though it is very rare for the ligament to be torn through that connects it with the radius and carpal bones.

Fractures situated very near to the lower end of the radius, are sometimes mistaken for dislocation of this bone, owing to the hand being pushed backwards and the radius being thrust forwards. Dislocation of the radius, however, is very seldom met with, and there are many opinions, as to whether it ever does occur at all.

Sir A. Cooper says, "This bone (the radius) is sometimes separately thrown upon the fore part of the carpus and lodged upon the scaphoid bone and the os trapezium. The outer side of the hand is in this case twisted backwards and the inner forwards; the extremity of the radius can be felt and seen, forming a protuberance on the fore part of the wrist." Dupuytren says, "A long time ago, I announced publicly in my lectures that these fractures (of the radius) are extremely common, that I have always seen the supposed luxations of the wrist prove to be solutions of continuity; and that the profession, notwithstanding so many descriptions, does not possess a single observation very convincing of this kind of lesion; I also observed that I had dissected wrist joints, and that I had never found dislocation in consequence of a fall upon the palm of the hand; that the only ones I have met with were consecutive to diseases of the joint, or symptomatic of other lesions."* I am inclined to agree with the latter opinion, for I have never seen the dislocation of the radius from a fall upon the hand, but have in more cases than one seen fracture low down mistaken for it. In these cases of fracture of the lower end of the radius, where the hand is displaced backwards more than laterally, and where the end of the bone projects forwards, the appearance very much resembles that of dislocation at first sight, but can easily be distinguished from it. The annexed woodcut represents the shape of the limb in these cases. A the depression, B the prominent end of the radius.



* Leçons Orales. tome 4me.

The great point to be observed, and which distinguishes the fracture of the lower end of the radius from dislocation of this bone, is the relative position of the styloid process with the base of the metacarpal bone of the thumb. For when fracture occurs, the articulating surface of the radius is in its proper place, and the styloid process of the bone keeps its place also, and is found to be opposite the base of the metacarpal bone of the thumb: and any displacement or deformity that exists will be found to be above this point, and none below it. Whereas, when dislocation of the radius occurs, all the deformity and displacement exist below the styloid process, the relative position of which to the metacarpal bone of the thumb is completely lost. This process can generally be felt, although the swelling round the joint elsewhere be very great.

It very often happens that the lower end of the radius breaks from a very slight cause, when the force is not sufficient to produce displacement of the fractured ends; these cases are liable to be mistaken for sprains of the wrist joint, for in both cases there may be swelling accompanying the injury; and in the fracture in this situation it is generally difficult, and often impossible, to produce the crepitus, or any sensible motion between the two portions of bone. I think I have found the following point assist me in distinguishing between these cases, namely, that where the joint is merely sprained, it will generally be found that the swelling present occupies the part below the styloid process, and that there is more swelling in this situation than above it: whereas in the fracture, it is just reversed, and there is found to be more swelling above the process than below it; at the same time

the lower end of the bone feels thicker than natural, more particularly when the inflammation begins to subside. In some cases, however, the swelling is very great, occupying both the wrist and lower part of the fore arm : under these circumstances, the above remark of course is of no advantage in assisting the diagnosis, and the nature of the injury is then very difficult to discover. The pain accompanying fractures of the lower end of the radius, is always greater than when the fracture is in the shaft of the bone; for the parts around the bone are generally more bruised, and the joint at the same time often becomes strained, and inflames, in consequence of the injury done to it. The symptoms indicative of fractures of the radius singly, are many of them the same as when both bones are broken. If the fracture be near the centre of the bone, there is often found to be an unnatural depression in that situation, accompanied with a twist in the shape of the limb, owing to the hand falling into pronation; the ulna side of the limb remains of its natural shape, the only deformity being at the wrist joint, where the hand is too much abducted. The patient has not the power of supinating the hand, owing either to the displaced position of the ends of the bone, or to the pain he experiences on making the attempt to move them. Motion and crepitus can generally be got where the fracture is through the centre of the radius; for the ends of the bone are easily unlocked, and the fractured surfaces can be rubbed upon one another. In these cases, where the lower portion of bone can be moved, the upper often remains quite stationary, while rotation of the hand is being produced; which can be ascertained by grasping the upper part of the fore arm, and pressing the thumb against the head of the radius.

When this point is very distinct, there can be no doubt about fracture being present. But it does not follow, as Petit and Desault assert, that because the two portions move together, therefore no fracture exists; for it often happens that the ends of the bone are fixed within one another, owing to the fractured surfaces being very irregular, when they cannot be unlocked, so that motion in the one portion must produce motion in the other also.

When the fracture is near to the wrist (in which situation the radius very often yields in old people), the crepitus may be difficult to produce, owing to the fractured surfaces being so broad, and preventing the ends of the bone, moving upon one another. The deformity that exists in these cases I have already described; and it is one that must be looked to in fractures very low down; for it is often sufficiently characteristic of the nature of the injury, although no motion or crepitus can be produced. The same precaution must be taken against mistaking the effusion of fluid round the joint, which often exists in fractures of the radius singly, and which was spoken of as occurring in fracture of both bones. The cause of the displacement in fractures of the radius, are the muscles and the force that produces the injury; and the two muscles that are generally described as acting upon the portions of bone, are the pronator radii teres and the pronator quadratus, the tendency of which is to pull the two ends of the bone into the interosseous space, or towards the ulna. It however depends greatly upon the situation of the fracture, whether they have any such effect; for when the injury is within the lower inch or inch and a half of the bone, I believe it to be almost impossible for these muscles

to have any effect in moving the fractured portions, for the surfaces are so broad and are generally so tightly locked together, that it requires great mechanical violence to move them upon one another, and such as the small pronator radii quadratus muscle could not exert. The only force that can produce the displacement in these fractures near to the wrist (without the bone be much comminuted), is the violence which produces the fracture, and which acts upon the bone after it has broken it, and so drives the ends inwards towards the ulna. I have had opportunities of examining two cases of fracture of the lower end of the radius, within a few hours after the receipt of the injury, where the patients have died from other injuries received at the same time. In both cases there was the peculiar characteristic deformity of the lower end of the fore arm and wrist, and which was found to be owing to the lower portion of the radius being driven forcibly inwards towards the ulna; but in neither could the displacement have been caused by the action of the muscles, for the ends of the bone were completely jammed and fixed together, in such a manner that it required great force to unlock them even in the dead body. When the fracture is towards the centre of the bone, the muscles may have some effect upon the fractured ends, but even in this situation the surfaces may be locked together so as to prevent them being moved laterally.

The ends of the radius are seldom displaced outwards, and for an obvious reason, namely, the interosseus ligament which connects the bone with the ulna and guards against separation in this direction; besides which, the force is seldom applied so as to tell against the bone in a line to push it outwards. Desault, however, mentions a case of a man who had the radius

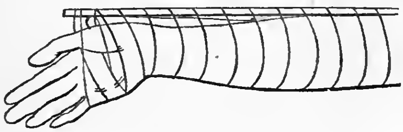
fractured by a large stone falling on the middle of the fore arm, so as to tell between the two bones, and drive the portions of the radius, after producing its fracture, "sensibly outwards; which position was discovered as soon as the swelling subsided."

TREATMENT OF FRACTURES OF THE RADIUS.

When speaking of fracture of both bones of the fore arm, the position of the upper portion of the radius was then fully considered, and the reasons given for supposing it to be more frequently brought into a state of supination than pronation. Those remarks apply equally well here, when the radius alone is broken, so that I need not again repeat them; and the position into which the limb is to be placed, where the fracture is toward the centre of the bone, is precisely the same, namely, that of extreme supination. There are points to be considered, however, where the fracture is near to the wrist, which require some attention with regard to the mode of applying the force in reducing the ends of the bone, that I shall mention directly. In reducing fractures of the radius, very little extention is required; for the shortening of the limb is very slight, owing to the ulna not being broken, and serving as a kind of splint to prevent retraction. If the ends of the bone are much depressed inwards towards the ulna, they must be pulled upon by making extension, at the same time that a kind of see-saw motion is given to them, by first elevating and then depressing the hand. The ends of the bone may often be unlocked, by suddenly supinating the fore arm to the utmost.

When the radius is broken, there is a tendency, as already stated, for the portions of bone to fall inwards

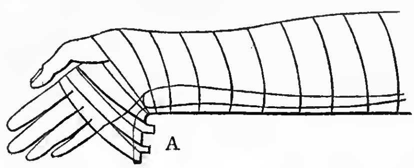
towards the ulna ; which tendency is greatly increased if the hand be at all brought into a state of abduction. To obviate this displacement, it is recommended to place a splint along the radial edge of the limb, having a firm compress beneath it. The splint must press upon the wrist joint and metacarpal bone of the thumb, and then be bound firmly down to it by passing a bandage round from the fingers up to the elbow,—the compress opposite to the wrist must be thick enough to push the hand downwards towards the ulna. The wood-cut represents the splint and the position of the hand.



It is supposed that when the hand is depressed in this manner, that the portion of the radius is dragged with it, and that the fractured end is drawn outwards from the ulna. I have already stated that I do not think this can have any effect, except when the fracture is in the shaft of the bone near to the centre, and that it will have little or none when the injury is close to the wrist, owing to the portions of the bone being so firmly locked against one another, that the hand cannot act upon them with sufficient force to displace them.

Dupuytren recommended a much more effectual way of depressing the hand, when it is considered advisable to do so : instead of employing the radial splint, he made use of what he called the ulnar splint, composed " of a bar of iron about an inch wide, of the length of the fore arm, and which at its lower extremity, opposite the part corresponding with the wrist, curves downwards in a semi-circle, to the concavity of which some

buttons are placed at equal distances." It is applied along the ulnar edge of the fore arm, with a firm compress, about an inch thick, placed just above the wrist joint, on the lower end of the bone and not extending beyond it. The long part of the splint is then confined to the fore arm by a circular bandage, and firmly fixed to it. When the bandage comes down to the curved part of the splint, it is to be passed round one of the buttons, and then over the hand and wrist joint, so as to depress or bring them as near as possible towards the curve of the splint: more force can be applied in this way than by placing the splint along the radial edge of the limb. The bandage may be passed many times round the hand and under the buttons until it is well fixed. The wood-cut represents the position of the hand when bound to the splint: A, marks the curve and buttons that fix the bandage that passes round the hand, and which confines it in extreme adduction.



When the position of extreme supination is employed, neither the radial or the ulnar splint is necessary, for then the portions of bone have not the same disposition to fall in towards the ulna.

The evil consequences that may arise after fractures of the radius, depending either upon the severity of the injury or upon neglect in the treatment, are impediment to the free motion of the bone upon the ulna, and weakness of the wrist joint. As already stated, it frequently happens that the motion of supination remains imperfect, and in severe cases is prevented alto-

gether, if the hand be allowed to fall too much into pronation, and if the ends unite in this position; which defect I have explained when speaking of fracture of both bones. The impediment to the motion of the wrist joint, generally exists in those cases where the fracture has been near to the lower end of the bone, when the joint at the same time becomes more or less strained and injured by the accident. In the comminuted fractures, the flexor muscles may be bruised and torn through, and so interfere with the motion of the hand, by not recovering their natural free action. The position of the lower portion of the radius will also interfere with the motion of the joint, in those cases where the hand is brought into abduction, and the ulna rendered prominent, which position is so often met with in old people, when the fracture is through the lower end of the bone. Another evil that sometimes remains after this fracture, is the false joint between the fractured ends of the bone, which generally occurs where the patient has used the fore arm at too early a period, or where the motion of the portions of bone has not been guarded against during the treatment.

FRACTURES OF THE ULNA SINGLY.

The ulna is often fractured by itself, but much less frequently than the radius; for it does not form so large a part of the wrist joint, and receives none of the shock, which is produced by falls upon the palm of the hand. It has peculiarities in its fracture which the radius has not; for it is differently shaped, and differently articulated, to the humerus, having two processes which that bone has not, namely, the coronoid, which is placed on the anterior part of the elbow

joint, and the olecranon process, which is situated behind. This latter forms a large prominence posteriorly, which is often exposed to injury, and on this account is often fractured. Fractures of this bone then may be considered under three heads, namely, of the shaft of the bone, of the olecranon process, and of the coronoid process.

The shaft of the bone is generally, if not always, broken by the direct force, when its fracture occurs without that of the radius; for the position of the bone, and its mode of articulation with the wrist joint are such, as not to bring it under the influence of the indirect force, without the radius be previously broken, so as to throw the weight of the body upon it. The most frequent cause of its fracture, is a blow from some hard substance applied directly to it, when the fore arm is raised above the head, which position then exposes the ulna more than the radius; or it may be caused by a person falling backwards, and striking the bone violently against some projecting body, as the edge of a step, &c. The majority of the cases of fracture of the shaft of the ulna that I have seen, have been caused by this latter kind of accident.

The situation of the fracture depends upon the part of the bone struck, for it always yields at the point at which the force is applied, and this may be in any portion of its length. The lower two thirds, however, are found to be more frequently fractured than the upper third; for this latter part of the bone is much thicker, and is stronger than the rest owing to its triangular shape. A *violent* force, however, easily breaks the bone in any part of its shaft, for it is not like the radius thickly covered with muscles, but lies very superficially at the posterior part of the fore arm,

where the force is generally applied that produces the fracture.

The symptoms indicating fractures of the ulna, are generally well marked, for the sharp margin of the bone behind being subcutaneous, allows of the part being easily examined, and any depression or motion of the fractured portions can be with facility ascertained. These symptoms, however, are more apparent in the lower half of the bone than in the upper half, for this portion is smaller and more easily displaced, and the fractured surfaces are not so liable to be locked together as they are in the upper portion, where often little or no displacement is met with. The crepitus can generally be produced in whatever part the fracture occurs, for the position of the shaft of the bone, allows of pressure being made upon it in the most favorable manner, by grasping the fore arm, and then pushing the two portions alternately towards the radius. The only displacement that can take place where the ulna singly is broken, is inwards towards the radius, causing deformity in the width of the limb. The length of the fore arm will not be altered, for the radius being sound will prevent retraction taking place. The upper portion of the ulna, in whatever situation the fracture happens to be (except when it is through the olecranon), always remains stationary, owing to its mode of articulation with the condyle ; it is the lower portion that moves from its natural position, owing to the hand being the most moveable part.

The causes of the displacement are three, and they all of them act to a certain extent when the bone is broken ; the first is, the force that produces the fracture, which at the same time drives the portion of

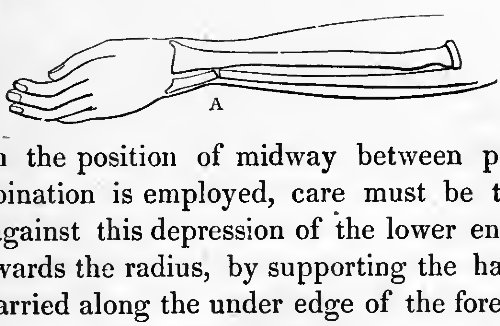
bone inwards. The second is the weight of the hand, which will always have a tendency to push the lower portion of bone towards the radius when it is allowed to drop. The third is the action of the pronator radii quadratus muscle, which will have the power of moving the lower portion of the ulna when the fracture is low down; though I do not think it has the same effect upon the portion of the radius when it is fractured very low down, for the fractured surfaces in the latter case are broad and locked together, while in the former they are narrow, and easily moved upon one another. The two former causes, namely the force that produces the fracture, and the weight of the hand dragging upon the portion of the ulna afterwards, act to a great extent, when the injury is near to the wrist.

The fracture of the shaft of the ulna being produced by the direct force, generally causes some bruising of the integuments opposite the part injured; this, in the majority of cases, is a guide to the point where the fracture may be looked for; sometimes, however, the swelling is too great to allow of the precise situation of it being ascertained. In these cases, as soon as the ecchymosis subsides, it becomes very apparent, for the hard ridge formed by the callus can be distinctly felt, and remains there for a long time after the patient begins to use his arm.

The motions of supination and pronation may be impeded when the ulna is broken low down, for the lower end of the radius which turns upon the ulna loses its fixed point to move upon, and so becomes weakened in its joint. The pain that the patient experiences also prevents him moving the one bone upon the other, when the fracture is in this situation.

TREATMENT OF FRACTURES OF THE ULNA.

The treatment to be recommended is very similar to that of fracture of both bones, only it is more simple, for now there is not the evil to guard against that exists when the radius is broken, namely the impediment to the motions of supination and pronation. I should still, however, advise the position of extreme supination, but for another reason, namely to take off the drag which the weight of the hand produces, when it is placed midway with the palm turned towards the chest; and this is more particularly the case when the fracture is situated within the lower two inches of the bone, for then the least dropping of the hand will tilt up the portion connected with it, as represented at A in the wood-cut. This point, however, is not so important to attend to where the fracture is within the upper half of the bone.



When the position of midway between pronation and supination is employed, care must be taken to guard against this depression of the lower end of the ulna towards the radius, by supporting the hand on a splint carried along the under edge of the fore arm, so as to prevent the hand falling into a state of adduction. The radial splint must never be used in these cases, for it only tends to produce the evil that it should be an object to prevent.

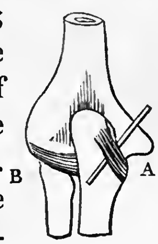
FRACTURES OF THE OLECRANON.

The olecranon process of the ulna forms so large a prominence at the back of the elbow joint, that it is

very liable to fracture when force is applied to it during falls, &c. It is most frequently broken by the direct force in the above manner, or by striking the elbow against some hard body without falling. It is, however, sometimes said to be broken by the action of the triceps muscle, which in some instances may be sufficient to cause it to snap, where the elbow joint is suddenly extended. I believe that many of the cases in which the process is supposed to be broken off by the action of this muscle, admit of being explained in another way; namely, by the ulna being thrown back against the humerus with great violence, which motion produces extreme extension, and throws the olecranon process forcibly against the humerus, which may be sufficient to break it off from the rest of the bone. The triceps no doubt in some cases may break the process, but it is a very rare kind of accident, the most frequent cause of the injury being a fall directly on the part.

When the olecranon process is fractured, it is generally, though not always, easily discovered. There is in the majority of cases, separation to a certain extent, with motion of the portion of bone, and a crepitus when the two surfaces are rubbed together. The degree of separation is not always the same, sometimes it is very great, being half an inch or an inch distant from the shaft of the bone, while at other times the separation is so slight, that it is scarcely perceptible and difficult to discover. When the process is retracted to so great an extent by the triceps, every connecting medium must be torn through, and the violence applied must have been very great, but when it is only slightly retracted the process of bone may be kept in its place, owing both to the capsular ligament not being torn,

and to the aponeurosis of the triceps remaining entire, where it passes down behind the ulna to be inserted some way beyond the extremity of the process. It sometimes happens that there is no separation at all, and that the only symptoms present, are the motion and crepitus produced by rubbing the portions of bone together. The cause of the absence of the separation in these cases, is very likely to depend on the existence of a band of fibres which passes up from the side of the coronoid process, backwards to the side of the olecranon. These fibres are described by Sir Astley Cooper in his work on Dislocations, as follows. "A band of ligamentous fibres crosses from the side of the coronoid process to the olecranon; and upon the radial side of the ulna, the upper portion of the coronary ligament of the radius passes from the side of the olecranon towards the neck of the radius. If the olecranon be broken off and these ligamentous fibres left entire, the olecranon will still remain united to the ulna by means of these ligamentous productions, which I should not have noticed but for their influence on fractures of this bone." I have taken the annexed drawing also from his work; A, represents the portion of ligament connecting the coronoid process with the olecranon; B, the portion of the coronary ligament connecting the radius with it.



When the displacement of the fractured process is but slight, one of the three above causes must exist; and I am inclined to give most influence to the capsular ligament, for this will not be torn through without the violence applied has been very great; and any force that would tear it, would tear through the bands

of fibres just described and the aponeurosis of the triceps as well. When the capsule is not torn, it will tend to keep the process in situ; for although the portion of the membrane that is situated above it is loose and flaccid, that portion which is attached to the side of it is firm and resisting. It does not always happen that the separation takes place at the time of the accident, for it may at a subsequent period, owing to some increased violence being applied to the portion of bone, either externally, or by the action of the triceps muscle. Mr. Earle mentions a case in his Practical Observations in Surgery, of a gentleman who fractured the olecranon, and where the separation did not take place 'till the sixth day after the injury, at which period it was caused by the patient attempting to tie his neck-cloth.

The situation of the fracture, will cause a difference in the degree of displacement that may take place; for the nearer it is to the shaft of the ulna, the more violent must the force have been to break it; and then the soft parts are torn through at the same time, and the triceps muscle allowed to act more easily upon it; whereas, when the fracture occurs very near to the extremity of the process, the violence applied is less, and the various ligamentous fibres are less likely to be torn through, and consequently will not allow of the fractured portion being so easily acted upon by the muscle.

If the separation be only slight, it may be increased by bringing the elbow into extreme flexion, when the shaft of the ulna will be carried forwards round the joint, and leave the fractured process behind it. The swelling that occurs is often so great, that if the patient be not seen immediately after the injury, it is

difficult to discover whether the process be fractured or not: but in many of these cases flexion of the elbow increases the distance sufficiently to indicate the situation of the separation, and the extent of it, when it cannot be discovered while the joint is in a state of extension. The motion of the fractured portion, however, and the crepitus, can generally be got with more facility when the arm is extended; for then the triceps is relaxed, as well as the capsular ligament at the posterior part of the joint. Sometimes the injury is attended with great ecchymosis round the bone, or with a wound of the integuments, causing the fracture to be compound. These cases require no peculiarity in their treatment, further than paying attention to the condition of the soft parts: the position of the limb is to be the same as in the simple fracture.

TREATMENT OF FRACTURES OF THE OLECRANON.

When the situation of the olecranon process, and the large muscle that is inserted into it, are considered, the treatment to be adopted suggests itself at once; namely, to keep the limb in that position which tends most to relax the triceps muscle, and at the same time allows of the portion of bone being brought down into contact with the shaft of the ulna. This is done by keeping the elbow extended, but not to the utmost; for then, as Sir Charles Bell observes,* "the olecranon which has been broken off, is pushed from its notch to the lower end of the humerus, and consequently it does not unite perfectly and correctly with the body of the ulna. In the natural state of the joint the olecranon checks into the hollow of the humerus, so as

* Operative Surgery, vol. 2nd.

to stop the motion at its due limit; but this check being now done away with, the fore arm may be bent back unnaturally, and the ligament of the joint strained." The opposite evil must also be guarded against, namely, that of flexing the elbow too much; for then the union that takes place will be weak, owing to the length of ligament that forms and connects the fractured surfaces together. The following is the mode of applying the splint that is to be employed. Let the fore arm be nearly extended to the utmost, having only a very slight bend forwards to prevent extreme extension; a bandage is then to be evenly applied from the fingers upwards to the point just below the bend of the elbow, and then given to an assistant to hold; the fractured process is then to be brought down towards the ulna, by pulling gradually upon it with one hand, while pressure is made upon the triceps muscle with the other, with the intention of *smoothing* it down towards the joint, and by this means to overcome any retraction of its fibres that may have taken place. As soon as the process is brought down as low as circumstances will admit of, the bandage is to be continued upwards round the elbow, taking care however not to press upon the fractured portion of bone, but to make it tell just above it, on the tendon of the triceps; the remainder of the bandage is then to be carried up the arm as far as the commencement of the axilla. The object of this first bandage is to confine the portion of bone and the muscles of the limb generally, and to make the pressure equable throughout. A strong, but elastic, splint is next to be applied to the anterior part of the elbow joint, which may be made either of thin wood or whalebone; it should be long enough to extend half-way up the arm, and the same distance down the fore arm: a soft pad should

be placed beneath it, and made rather thicker at the part opposite the bend of the elbow, as there will be a slight hollow in this situation, owing to the joint not being in extreme extension. This splint is to be confined by passing a bandage round it, and making it tell more, just above the fractured portion of bone than below it. Sometimes the portion of bone is better confined by making the bandage pass round the joint in the shape of the figure of 8, and including it between the turns of it; or it may be confined by two lateral strips placed one on either side of the olecranon, at the back of the joint, and making them pull upon two circular strips which pass above and below the process, and which will be brought together when the lateral portions are tied, in the same manner that the fractured patella is sometimes treated. In most cases, however, it is only necessary to confine the bone by means of the bandage carried circularly round the limb, which keeps the portions sufficiently fixed, and guards against displacement.

If the fracture be compound, or attended with much bruising of the soft parts, the patient had better remain in bed for a few days, until the inflammation has subsided sufficiently to allow of some attempts being made to confine the portions of bone. The best treatment under these circumstances is, to lay the whole limb upon a long pillow with the elbow extended, and the fore arm and hand in a state of pronation: which position will remove all pressure from the injured part, and leave it exposed for the application of leeches, poultices, &c., as the condition of the joint may require. If the fracture be only simple, it will not be necessary to confine the patient to his bed; but the splints may

be applied immediately, and the arm kept by the side. The period at which the splints may be discontinued, is between the third and fourth week; when passive motion may be given to the joint, either by the patient himself moving it with the opposite limb, or by getting an assistant to do so for him. Care should be taken to give but very slight motion at first, and to discontinue it as soon as pain is produced; otherwise inflammation will be liable to be brought on.

There is an interesting point connected with this kind of fracture, viz.: whether the fractured portion ever becomes united by bone to the shaft; the general opinion is, that it does not, but that it is only joined by ligament like the patella. I believe that in the majority of cases this will be found to be true, but that it is owing to the difficulty of keeping the surfaces of bone in exact apposition, and not to any physical cause in the part itself, dependant on this portion of bone being connected with a joint; for I am certain that I have seen cases where the close apposition of the ends of the bone has been obtained, in which ossific union has been produced, or something very like it, for not the least motion has existed afterwards, and a distinct ridge of substance like bone has been felt opposite to the point of fracture. I have not, however, had an opportunity of examining a case after death under these circumstances. The same reason does not apply here that does with fractures of the neck of the thigh bone; for in the latter case, the ends of the bone may be completely isolated from the adjacent textures, whereas in the fracture of the olecranon the injury must always communicate externally as well as with the joint. The same cause

exists to prevent the olecranon uniting, that prevents the patella from joining by bone, namely, the difficulty of keeping the fractured portions in exact and close contact.

FRACTURE OF THE CORONOID PROCESS OF THE ULNA.

This is a very rare kind of injury, owing to the situation of the process, and the difficulty of getting a force to tell upon it in a direction that will be liable to break it; for the most likely kind of force to act upon the part, is one that tells vertically upwards through the shaft of the ulna, and pushes the process against the condyles; but it is very difficult for the force to tell in this direction, owing to the lower end of the ulna being so small, and receiving so small a portion of the shock, when a person falls upon the palm of the hand; were it as broad as the lower end of the radius, no doubt the process would be more frequently fractured than is now found to be the case. The action of the brachialis anticus muscle is sometimes said to fracture the process: this must be very rare however, for the bone is not now so favorably placed for it to take effect upon it as it is when the fracture occurs in the olecranon or the patella. In the two latter cases the muscle may snap the bone across; whereas in the coronoid process, it acts by pulling vertically upon it, and in a direction unlikely to fracture it. The muscle will be more likely to separate the process in young people than in adults. Mr. Liston mentions a case in his Operative Surgery, of a boy who broke the coronoid process by the action of the brachialis muscle while hanging from a high wall, being afraid to drop.

The symptoms of this kind of fracture are not very apparent; for it is not possible for the portion of the

process to be much retracted, owing both to the insertion of the capsular ligament into it, and to its lying so deeply buried under the muscles of the fore arm. I have only seen one case of this injury myself, and then the process was felt more prominent than natural, when the arm was extended, but very little retraction was present. Another symptom that may exist in these cases, is the projection of the ulna, posteriorly, in a greater degree than natural, and more so when the elbow is extended; which deformity however becomes redressed as soon as the joint is flexed again.

The treatment to be adopted is very simple in its principle; the joint is to be flexed, and the fore arm to be rolled from the fingers up to the elbow; the fractured process is next to be pressed downward towards the ulna, and to be kept there by placing a piece of pasteboard along the anterior part of the arm against the biceps muscle, so that the lower end of it may press down into the bend of the joint, and upon the coronoid process; a pad of lint is to be placed under the pasteboard, which is then to be confined by a bandage carried circularly up the arm. The limb is now to be placed in a sling, and to be kept there from five to six weeks, or for a longer period: for the peculiarity of this fracture is, that it generally, if not always, unites by ligament.

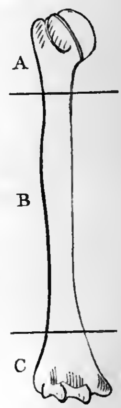
The number of cases that have been examined after death, where the coronoid process has been fractured, is very small; and I am not aware of any being on record of the bony union being produced. Sir A. Cooper says: "As to the treatment of this accident, I am doubtful whether any mode can completely succeed, as the coronoid process like the head of the thigh bone, loses its ossific nourishment, and has no other

than ligamentous support. Its life is preserved by the vessels of the reflected portions of the capsular ligament upon the end of the bone, which do not appear capable of supporting the least attempt at ossific union, nor is any change in the surface of the bone apparent." This diminished vascularity in the portion of the bone broken, is no doubt a cause sufficient to retard the ossific process, but not to prevent it altogether. One great reason of bony union not taking place, I believe to be the difficulty of keeping the fractured surfaces in contact, and pressed against one another.

FRACTURES OF THE HUMERUS.

THE humerus presents many peculiarities in its fracture, for the muscles attached to it are numerous, and pull in opposite directions; so that the fractured portions may be displaced many ways, and will be very differently so according to the part in which the fracture happens to be situated.

The bone is divided into the head, neck, shaft, and condyles; the shaft of the bone is the part most frequently fractured, then the surgical neck as it is called, and the condyles, and least frequently of all the head of the bone. The head of the bone is the round portion that forms the shoulder joint; the surgical neck, that portion that is contained between the round head and the upper margin of the insertion of the pectoralis major muscle, and is marked A in the wood-cut. The shaft of the bone is contained between the neck and the condyles, and is marked B. The condyles, C, are situated at the lower end of the shaft, in the broad portion that spreads out to form the articular surface for the bones of the fore arm to move upon.



FRACTURE OF THE SHAFT OF THE HUMERUS.

The shaft of the bone may be broken either by the direct or indirect forces; when the direct acts, it generally happens that a weight of some kind falls upon

the part, or that the bone is struck against some hard substance. When the indirect force causes the fracture, it acts upon a part of the bone remote from the point struck, as when a person falls with the arm extended from the body, the elbow may be the part that receives the shock, but the shaft of the bone may be the part to yield. The cases of fracture by the direct force, are generally accompanied with bruising of the integuments and muscles round the bone, which becomes apparent shortly after the accident, by the discoloration of the skin that takes place; the ecchymosis in some of these cases is very great, extending from the elbow up to the shoulder. The indirect force seldom causes much injury to the soft parts, and the ecchymosis is in the majority of cases very slight, when the fracture is produced in this way.

The humerus is sometimes broken by the action of the muscles surrounding the bone; I have seen two cases of this kind, in which the fracture occurred in precisely the same manner; I shall give one of them.

Case.—John Barker, æt. 26, a very tall, powerful man, applied at the Middlesex Hospital, December 26, 1831. He stated that he was trying with another man to see which possessed the stronger arm, by each of them resting their elbow upon a table and placing the palms of their hands in contact, and then endeavouring, the one to press the other's hand down, and he who succeeded in doing so was to be the conqueror. After trying this for a few minutes, he felt something in his arm suddenly snap, as he says, "like the report of a gun," giving a sensation as if somebody struck him a smart blow on the part, and it required some difficulty for the by-standers to persuade him that such was not the fact. The humerus was found to be

fractured transversely about three inches above the condyles, there being no shortening of the limb. The bone united in the usual time.

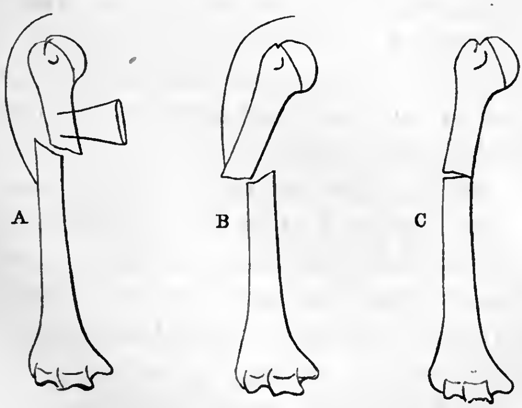
In April, 1835, another man applied at the hospital, with precisely a similar injury and produced in the same manner; the fracture was situated in the same part of the bone, and united without any bad symptom.

The humerus may be broken by a force telling through the fore arm, as when a person falls with the arm extended, and comes upon the palm of the hand, with the radius and ulna too perpendicularly placed to allow of the force telling upon them; these bones may then be driven forcibly against the condyles, and cause them to break, or some part of the humerus above them. A smart blow struck with the fist against any hard substance may fracture the shaft of the bone, of which the following case is an example.

Case.—William Wayling, æt. 24, May 5, 1835, was quarrelling with a man, who was running at him to strike him, when he put out his arm suddenly to stop him, and aimed a blow at him at the same time; he struck his fist against the man's face, and immediately felt something in his arm snap, and it fell by his side useless. It was found that the humerus was fractured at the junction of the lower with the middle third. The bone united well and within the usual period.

The shaft of the humerus may be broken in any part of its length and in any direction; the most frequent situation for the fracture to occur in, is within the lower two thirds of the bone, and the direction it takes is most frequently transverse; it is, however, sometimes oblique. If the fracture be transverse, the displacement that takes place may be very slight and

often none at all, for the fractured surfaces remain in contact and are not easily moved from their apposition; the force, however, that causes the injury, may push the ends past one another, and then their line of contact being lost, the muscles can easily act upon them. But in these cases when the fracture is once reduced, the portions of bone do not become again displaced, without fresh violence be applied to them, so as to disturb their apposition. In the oblique fracture, the muscles easily act and draw the portions of bone past one another, for they are not now locked together as in the transverse fracture, so that the displacement that occurs may be great, and is found to be more so in some cases than in others, depending on the situation of the fracture. If the fracture be below the insertion of the teres major, latissimus dorsi, and pectoralis, and above the insertion of the deltoid, the upper portion of bone will be drawn inwards towards the thorax, while the lower portion is drawn upwards by the muscles that pass from the scapula down to the elbow, and outwards by the deltoid, as represented at A, in the wood-cut.



If the fracture be oblique, and below the insertion of the deltoid, the upper portion of bone will be drawn more outwards, and the lower one will fall inwards; and, if the apposition be not altogether destroyed, the limb will remain of its proper length, as represented at B; but if the ends of the bone are out of contact, it will then be shorter, owing to the lower portion being drawn upwards. In the transverse fracture, where the contact of the ends of the bone is not destroyed, there may be deformity of the limb, although it will not be shortened; for the lower portion of the bone will fall inwards towards the thorax, owing to the elbow now lying close to the side, which it does not naturally do, but stands slightly out from it; but when the bone is broken, the elbow loses its support from above, and then becomes perpendicularly placed with regard to the upper portion, which still remains slightly oblique, and will be pulled more so by the action of the deltoid, if the fracture be below this muscle. The position of the portions of bone is seen at C, in the wood-cut.

The shortening of the limb in fractures of the humerus exists much more in some cases than others, and is dependant on the degree of obliquity the fracture has taken. As a general rule, however, it is not very great in any case; and much less so in this than in other kinds of fracture; for the weight of the elbow and fore arm are sufficient to counteract the spasm of the muscles, that tend to retract the lower portion of bone, without it be very violent. In the majority of cases the deformity is greater in the outline of the limb, owing to displacement angularly, rather than in the long diameter of the bone.

Sometimes the shaft of the humerus breaks just

above the condyles; an accident that is frequently met with in boys, from falls, either upon the hand or upon the elbow. In these cases there may be displacement of the condyloid portion of the bone backwards, and of course of the radius and ulna with it, so giving something the appearance of dislocation of both bones backwards. The fracture, however, can be easily distinguished from the dislocation by attending to the following points:—Ascertain the prominences of the two condyles of the humerus, and then observe if the ends of the radius and ulna bear their proper relation to them; if fracture be present, their relative position to one another will be natural, but the condyles will not be perpendicularly under the shaft of the humerus;—whereas, if dislocation backwards be present, the condyles and the shaft of the bone will have their natural line with one another, but the radius and ulna will have lost theirs, and their extremities will be found to be much farther from the condyles than they ought to be, were their articular surfaces in contact. In the fracture, the displacement takes the condyles with it—in dislocation, it leaves them behind.

The symptoms of fracture of the shaft of the humerus are in general so evident, that it is hardly possible to mistake the nature of the injury. There is found to be motion in some part of the limb, where naturally none ought to exist; which can easily be produced by grasping the elbow, and then bringing the lower portion of bone with it from the side; or, if this action does not produce it, rotation may be employed, by turning the elbow suddenly inwards or outwards. During either of these motions a crepitus can be got; which confirms more decidedly the nature of the injury. The

direction of the displacement is indicated by the position of the ends of the bone, which can generally be ascertained by observing the shape of the limb, and feeling for the projection which will be formed by them, if they are not in contact.

The above symptoms are always sufficient to indicate the nature of the injury. The pain and inability to move the limb, which are generally present, must not be taken by themselves as diagnostic symptoms; for they may exist with a simple bruise of the muscle, without any fracture at all. If the fracture be just above the condyles, and there be great swelling present, the nature of the injury will not be so apparent, for the different prominences of the bone cannot be felt. In these cases, however, there is generally one symptom that will decide that it is fracture, and not dislocation; namely, the power of flexing and extending the elbow, and the easy reduction of the deformity, which often takes place again, as soon as the extension is discontinued: whereas in dislocation, the elbow joint is stiff, and the deformity cannot be reduced without applying great violence.

TREATMENT OF FRACTURES OF THE SHAFT OF THE HUMERUS.

The mode of reduction and the treatment of fractures of the shaft of the humerus are, in the majority of cases, simple and easy, owing to the shape of the limb and its situation offering great facility for the application of splints. The reduction of the displaced portions of bone is accomplished by grasping the lower part of the humerus and elbow with one or both hands, according to the size of the patient's arm and the resistance made by the muscles, so as to bring down

the lower portion of bone, and to place the fractured ends in contact. Some recommend that the arm should be brought out at right angles with the body during the reduction, and that the splints should be applied to the limb while it is in this position; but I think there are objections to this plan, for the ends of the bone cannot be so easily held in apposition during the bandaging, and the least falling of the fore arm will rotate the lower part of the humerus with it, while the upper remains stationary. This position also puts many muscles on the stretch, which are completely relaxed while the limb is left down by the side, viz.: the pectoralis major, teres major, and latissimus dorsi. Another evil is, that if the splints be applied while the arm is in the horizontal position, the alteration which takes place afterwards by bringing it down to the side, puts the deltoid into action, and pulls the lower end of the upper portion of bone outwards, at the same time that the bandage by the axilla will be tightened in some parts and loosened in others.

The best treatment is, to keep the arm extended downwards, merely separating the elbow from the side, sufficiently to allow of the bandages being applied. The limb is to be held firmly in this position with the elbow flexed, and a bandage then must be applied from the fingers upwards, round the elbow, and then up to the axilla; the object of this first bandage is to confine the muscles generally, and to make equal pressure on the vessels, taking care that less pressure is made at the bend of the elbow than elsewhere. Four lath splints are then to be applied, placing them on the inner, outer, fore, and back part of the limb. The inner one should be applied first and must be the

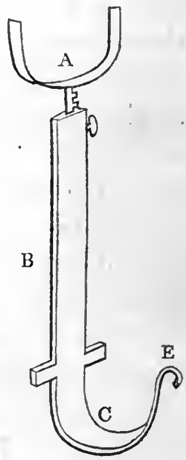
broadest, it should be long enough to extend from the axilla down to the inside of the elbow beyond the condyle; a pad is to be placed upon it, its thickest part being just above the internal condyle, to fill up the hollow that this prominence leaves in this part of the bone; a few turns of bandage may be passed round this first splint to confine it before the others are applied. The other three splints need not be very strong or very wide; their length, however, must be sufficient to extend from the acromion process down to the elbow, the outer and back ones going quite to the end of it, the anterior one stopping just above the bend, so as not to press upon the skin of the fore arm. These three splints are then to be confined by the same bandage that was passed round the inner splint, if it be not exhausted, or by a fresh one if its length be not sufficient. When they are all firmly fixed, the arm should be placed close to the side, having a small pad only opposite the inside of the elbow, to guard against the pressure of the splint, and to keep the line of the humerus slightly oblique, as it naturally is when unfractured. The whole arm should then be confined to the chest, by a few turns of bandage carried round it, and under the opposite axilla. I believe this to be of great use in keeping the muscles quiet, and more particularly where the fracture is just below the insertion of the deltoid, for it will be often found that this muscle acts strongly while the elbow stands out from the side, but that it ceases to act immediately on its being brought close to it; this position of the limb also gives the patient great comfort, for the arm is more steadied, than when it is not so confined to the chest, but merely supported in a sling. I believe that advantage will be derived, from

so fixing the arm to the side in all fractures of the humerus above the condyles.

If the fracture be quite at the lower end of the shaft of the bone, just above the condyles, there is often a disposition for the elbow and lower portion of bone to be drawn backwards; when this is the case, the deformity must be guarded against, by having the back splint stronger than usual, and by applying one at the anterior part of the joint, bent at right angles, so as to fit into the bend of the elbow and to pass down the fore arm. Mr. Amesbury makes the back splint pass down behind the fore arm, by having it bent at right angles also. I do not, however, think this is necessary, if the anterior one fit well and if the back one be strong and unyielding, for if it be firmly fastened at the upper part of the limb above the fracture, the lower portion of bone cannot be pushed backwards. In these cases, the arm should be supported in the sling, letting the elbow drop, by making the lower part of the fore arm and hand rest more upon it than the upper.

When the fracture is very oblique, and just below the insertion of the deltoid muscle, it is often very difficult to prevent the one portion of bone being drawn beyond the other; the consequence of which is that the upper portion is pulled outwards, and the lower one upwards, causing displacement and shortening of the limb, as represented in figure A, page 167. I have seen cases of this kind, where the common mode of treatment, namely, by merely bandaging the limb, and using lath splints, has been of no use; but owing to the obliquity of the fracture, retraction has taken place, and the upper portion of bone projected outwards. To obviate this kind of displacement, I in-

vented the following form of splint, which appeared to me to gain an advantage that is wanted in some of these cases, namely, the power of keeping up extension. It consists of a thin bar of iron, about an inch and a half wide, and long enough to extend from the axilla down to the elbow, marked B in the wood-cut. The lower end of the bar curves upwards underneath the elbow, so as to allow of this part of the limb fitting into it, at C. This curve terminates in a kind of hook, E, to fasten a bandage to; and at the point of the splint, opposite to this hook, there are two small lateral bars or pegs placed, lying flat with the rest of the splint, to fix a bandage to also. To the upper part of the splint there is a crutch placed, represented at A, which fits underneath the axilla, and slides up and down, being fixed at pleasure by a small screw, placed at the side of the vertical bar. When the splint is applied (the fore arm and arm having been evenly rolled from the fingers upwards, and the splint itself well padded), the crutched extremity of it must be pushed upwards into the axilla, and the elbow fitted into the curve C, made to receive it. The elbow is then to be fixed in this position, by passing a bandage round the hook E, and over to the two lateral pegs on the opposite side of the splint, by which means this part of the limb will be firmly fixed: the bend of the elbow should be padded, and have a piece of pasteboard or splint laid across it, to prevent the bandage cutting the integuments. Having fixed the elbow, extension is to be made upon the arm, by pulling the lower portion of the limb downwards, while



the crutch is pushed upwards under the axilla; and when the ends of the bone are brought into apposition, the crutch is to be fixed, by turning the screw that fits into the teeth of the slide that connects it with the vertical bar. Shortening of the limb cannot now take place, for the elbow cannot be drawn upwards, on account of the crutched extremity which presses against the axilla. One or two lath splints may be applied as well, on the outer or fore part of the limb, and be confined by a bandage or leather straps, so as to fix the arm to the shaft of the splint B.*

It is not often, however, that the treatment by counter-extension is required for fractures of the humerus; for, in the majority of cases, the simple lath splints and circular bandage are all that is necessary; but I have certainly seen cases where the fracture has been very oblique, and below the insertion of the deltoid, that have required something more, and where the crutched splint, recommended above, has been of service; in preserving the correct apposition of the ends of the bone.

In compound fracture of the humerus, when the soft parts are so much injured as to prevent the application of splints, the patient should be kept in bed some days, until the wound has sufficiently recovered to bear pressure being made upon it. During this period the arm should be supported on pillows, with a splint placed beneath them, and local applications made according to the nature of the wound and the degree of inflammation present. The fore arm, in these cases, should generally be bent and brought across the chest, by which the muscles are relaxed, and the line of apposition of the portions of bone better preserved.

* Vide London Medical Gazette, vol. xv. p. 829.

FRACTURES OF THE NECK OF THE HUMERUS.

The neck of the humerus is, surgically speaking, that part of the bone which is contained between the margin of the round head and the upper edge of the insertion of the pectoralis major muscle; anatomically, however, the neck of the bone is merely that small portion that is contained between the head of the bone and the tubercles. This part of the bone is very rarely broken, the fracture generally taking place in the surgical neck.

Fractures of this part of the bone, are most frequently, if not always, produced by force directly applied, either from a blow upon the part, as a kick from a horse, or from the person falling and striking the upper part of the arm against some hard resisting substance. The anatomical neck is generally broken, in very old people, and a force acts more easily upon this part of the bone for three reasons; one is, that the bone itself is more brittle; a second is, that the soft parts around have wasted to a certain extent, and so do not deaden the blow so much when force is applied; a third is, that old people fall with more *weight* than young, so that the actual force applied to the bone tells with greater violence, and will be more likely to break this part of the bone than in a younger person, in whom these unfavorable circumstances do not exist to the same extent.

The symptoms of fracture of the anatomical neck of the bone, when it does occur, are flattening of the deltoid, dropping of the elbow, inability to move the arm, and motion of the shaft of the bone without the head of it following, which can be felt by grasping the elbow and then rotating the lower portion of bone,

while the head of the bone is fixed by pressing the finger and thumb forcibly underneath the acromion and coracoid processes of the scapula: during this motion there will also generally be produced a crepitus. The flattening of the deltoid and the inability to raise the arm, are two symptoms that might lead to the supposition of the bone being dislocated instead of being fractured, but the following points will distinguish between the two injuries. First, the depression under the acromion is not so great as in dislocation; for there is still the round head of the bone remaining in the glenoid cavity. Second, the position of the elbow is different; for, in the fracture, it falls close to the side, whereas, in dislocation, it stands out, owing to the head of the bone falling into the axilla or under the pectoral muscle. Third, in fracture of the neck of the bone, the shaft is easily moved in various directions; whereas, in dislocation, the bone allows of very little motion, and this only to a very limited extent. The absence of the head of the bone in the situations in which it is generally found in dislocation, cannot be taken as a sure diagnostic symptom; and more particularly where there is much swelling present, for the fractured end of the shaft of the bone may be drawn inwards under the pectoral muscle, and give the sensation of the head of the bone itself being there; the free motion that exists, however, will distinguish between the two; and if the person be thin, and no swelling be present, the difference in size of the portion of bone will distinguish it from the round head. The treatment of these cases of fracture of the anatomical neck of the bone, is very simple, for it is only necessary to place a pad in the axilla, in order to push out

the shaft of the bone, and to brace the arm down to the side with a bandage carried circularly round the chest; the elbow must also be well supported in a sling, to keep the humerus pressed upwards in the glenoid cavity.

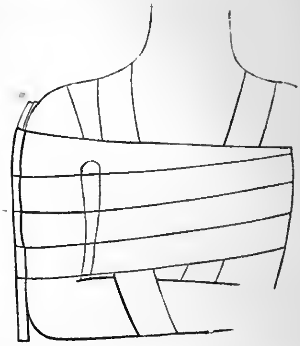
Fracture of the surgical neck of the humerus is not an uncommon accident, and the symptoms are generally very evident and not so liable to be mistaken for dislocation; though, in very fat people, the nature of the injury is sometimes obscure, owing to the difficulty of feeling the boundaries of the joint and the prominences of the bone. When the fracture is situated above the insertion of the pectoralis, latissimus dorsi, and teres major muscles, and below the tubercles,— the portions of bone may be displaced, as represented in the wood-cut; for the shaft of the bone will be drawn inwards by the action of the muscles just mentioned, which are inserted into the bicipital groove, and the upper portion may be tilted upwards and outwards by the action of the supra and infra spinatus muscles. The shaft of the bone may also be drawn upwards by the action of those muscles that pass down from the scapula to the elbow, namely, the biceps flexor and the triceps extensor cubiti. The deltoid will also

tilt it inwards and pull it upwards. The flattening of the shoulder in these cases is not present, as when the anatomical neck of the bone is the seat of the injury, for now there is the round head and the greater tubercle projecting beneath the acromion, and so preventing the deltoid being depressed. If there be any flattening at all, it is much lower down, being opposite the

point where the end of the shaft of the bone is drawn inwards. The position of the elbow is generally closer to the side than in dislocation; for although the upper end may be displaced under the pectoral muscle, the weight of the fore arm soon brings it out from this position, and allows of it dropping down to the side. In dislocation, the head of the bone being so much larger than the fractured end of the shaft, causes it to be more fixed, and to be less easily acted upon by the weight of the limb below.

In some of these cases of fracture of the surgical neck of the bone, a great deal of retraction takes place, and the fractured portions appear to be locked together. I lately saw a case of this kind in a boy, about twelve years old;—the fracture was situated apparently through the epiphysis of the bone, being about an inch below the tubercles; the fractured end of the shaft of the bone was projecting anteriorly under the acromion, being almost through the integument. The portion of bone was so jammed in this position, that long continued extension, and very violently applied, could not reduce it; the joint was not injured, and the bone united with no other deformity than this small prominence that was felt beneath the skin. It was difficult in this case to say upon what the opposition to the reduction depended, for the muscular power of the boy was small, and acted but very slightly.

The treatment of fractures of the surgical neck of the bone, differs but little from that of the anatomical neck; the pad that is placed on the inside of the arm must be longer, and extend down to the elbow, the upper part of it being the thickest; a thin lath splint may be applied down the outside of the arm, from the acromion to the elbow, to make equal pressure



against the outside of the limb, and to prevent the bandage that confines the arm to the side pressing the fractured ends inwards. The whole arm must be braced to the chest by a circular bandage carried round it, one or two turns of which may pass over the shoulder, under the fore arm to make a sling, taking care that it presses more at the wrist than the elbow, so as to allow the weight to tell upon the lower portion of bone, and thus to oppose the disposition to retraction upwards. The wood-cut represents the position of the limb. Most of these cases of fracture of the neck of the humerus are much easier to treat, than those of the shaft of the bone; the great point to attend to, being the prevention of the upper end of the shaft of the bone from falling inwards, and to let the elbow drop in order to keep up slight extension.

The prognosis of fractures through the neck of the humerus, whether it be the surgical or anatomical, is often very unfavorable, but more particularly in the latter case; for that of the anatomical neck of the bone, as already stated, most frequently occurs in old people, and is caused by a very violent kind of force, which at the same time does great mischief to the shoulder joint generally; the consequence of which is, that the muscles and ligaments become inflamed, and to an extent to require the repeated application of leeches, or to have blood taken away by cupping, which latter is perhaps the best treatment in these severe bruises of joints, that are thickly surrounded by muscles.

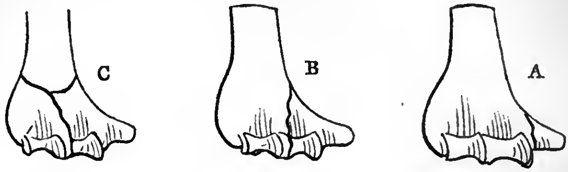
The fracture in these cases is very often a long time in uniting, and requires the arm to be kept a long period in a state of confinement, during which period the motion of the joint in an old person often becomes impeded, owing both to the inflammation and injury done to it, as well as to the wasting of the muscles, and more particularly of the deltoid, which is not an uncommon circumstance to meet with after a severe injury to the shoulder joint. Fracture of the surgical neck of the bone is not so serious an injury, for the accident generally occurs in younger people, and the violence of the force that acts upon the part is also less; another, and the most important reason, is, that the joint is not so likely to be injured or bruised.

FRACTURE OF THE CONDYLES OF THE HUMERUS.

When the condyles are fractured, the injury becomes of a very serious nature, owing to the joint being implicated; which renders the accident one requiring the most active treatment; at the same time that it often terminates unfavorably, and renders amputation of the limb necessary to save the patient's life.

Fracture of the condyles occurs more frequently in young than in adults or old people; for in young people this portion of the humerus is much weaker, owing to the ossification not being completed, and to the bone, on this account, being less capable of resisting violence, when applied to it, than the shaft of the bone. The fracture may extend in three directions: First, the extremity only of either condyle may be broken off, as represented at A, in the wood-cut. Secondly, the fracture may include a larger portion of one condyle only, but extend directly into the joint, B. Thirdly, both the condyles may be separated from

one another, and from the shaft of the bone as well, as represented at C, in the wood-cut.



The most frequent and the least injurious kind of fracture, is that where the prominence of the internal condyle only is separated; which may be caused by the part being struck directly against any hard substance, during falls, &c. The symptoms are very evident, if there be no swelling present; for the separated portion of bone can be easily moved, and a crepitus be produced. There is no alteration in the shape of the joint in these cases; for this portion of the bone takes no part in supporting the ulna, and there is very little displacement; for the capsular ligament, as well as the origin of the numerous muscles adhering to it, keep it in apposition with the rest of the bone.

Fracture through one or both condyles is not a very rare accident: it may be caused by the direct force, as from a fall upon the elbow, or from a heavy weight falling on it; or by the person falling forwards on the palm of the hand, and driving the bones of the fore arm forcibly against the lower end of the humerus. It is seldom that the condyles are split into more than two or three pieces, without the force has been very violent indeed.

The symptoms of fracture through the central portion of the condyles, are not very apparent, without the patient be seen immediately after the injury; for perhaps no joint takes on swelling sooner, or is more

easily inflamed than that of the elbow; the consequence of which is, the soft parts around soon become swollen, and obscure the shape of the part, and prevent the detection of any unnatural prominence, without it happen to be very great. The symptoms that are generally met with, are pain in the joint, which is increased on the slightest motion;—motion between the fractured portions of bone when pressure is made upon them, or when the joint is moved; displacement of the portions of condyle and of the bones of the fore arm as well, if they both are separated: but when one condyle only is detached, there is not often much alteration in the relative position of the parts, owing to the ulna or radius keeping their place; which they need not when both condyles are broken, for then the whole joint may be displaced backwards, and take the condyles with it. In the majority of cases, a crepitus can be produced during the motion of the portions of bone: but this does not always happen; for there may be great effusion into the joint, as well as great swelling external to it, which may be sufficient to prevent motion being given to the portions of bone, or to prevent them rubbing together when such motion can be obtained.

Fracture through both condyles, so as to separate them from the shaft of the bone, may be accompanied with so much displacement backwards, that the injury will very much resemble dislocation in this direction; but the two injuries can generally be distinguished from one another by attending to the following points, which can almost always be ascertained, except in some cases where the swelling is very great indeed. Feel for the prominence of the two condyles, and for the heads of the radius and ulna, and then observe

their relative position to one another. If there be fracture, it will be natural; but the condyles will be found to be posterior to a line drawn vertically through the shaft of the bone. If the injury be dislocation, the relative position of the condyles, and radius, and ulna, will be unnatural; but the condyles and the humerus will be in their right line, for there is now no separation of the two, the articular surfaces only being displaced, and the continuity of the bone itself not being at all destroyed. Another distinction is, that in fracture the elbow can be flexed and extended, whereas in dislocation it remains stiff. If the displacement backwards be very great, another symptom will be present, namely, the shortening of the humerus, owing to the lower portion of bone being retracted. These points are generally sufficient to decide upon the nature of the injury; but if any doubt should still exist, owing to some of the above symptoms not being well marked, measurement may be taken from the following points. First, from the prominence of the outer condyle down to the styloid process of the radius; and then measure the same points on the opposite limb. If the two correspond, fracture is present; but if the injured side be shorter, then the deformity is owing to dislocation: for the shortening between the above points shews that the articular surfaces of the radius and ulna have lost their apposition with the condyles. Secondly, if there be retraction of the lower portion of bone upwards, behind the shaft, measurement from the outer condyle to the acromion process will shew the distance to be shorter than on the sound side; whereas in dislocation, it would be the same on both sides, owing to the continuity of the humerus being perfect.

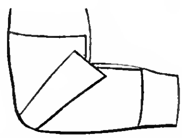
In examining fractures through the condyles, both

of them should be grasped, and motion be given by forcing them in opposite directions; during which action the crepitus can generally be got as well. Motion can sometimes be given to the fractured portions, by pushing the fore arm backwards or pulling it forwards, and by flexing and extending the elbow.

In the reduction of this kind of fracture, very little is required when the whole or part of one condyle only is separated, for then there is little or no displacement; but when the fracture extends through both of them, the elbow, as already stated, may be pushed backwards. In these cases, force requires to be applied in a direction, to bring the condyles forward and opposite to the shaft of the bone; and this may be done by grasping the elbow, and making extension downwards, at the same time that the fore arm is pulled forwards. Should this kind of force not be sufficient, the knee may be placed in the bend of the elbow, and extension made round it, by pulling upon the fore arm in the same manner as in reducing the dislocation of both bones backwards. In some cases the swelling is so great that it is difficult to reduce the fracture, where the patient has not been seen till some time after the accident: and if the inflammation be high, it is imprudent to try to do so; but time should be given for the swelling to go down, and for the inflammation to subside by the application of leeches, cold lotions, &c. The use of ice in these cases is very great; for it tends speedily to reduce the swelling, and so allows of the earlier reduction of the portions of bone.

The mode of fixing the fractured condyles, consists in moulding a piece of pasteboard to the shape of the joint, so as to press equally round it in the following man-

ner :—Take a piece of pasteboard, sufficiently long to extend from three to four inches above the elbow, and for the same distance below it, and wide enough to surround the joint laterally, so as to almost meet in front. To make it fit the shape of the part, it is to be notched either in one or two places on each side, so that the separate portions may overlap one another as represented in the wood-cuts, A. B.



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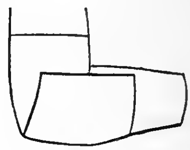


B

The double notch, A, is perhaps better than the single one, B, for it leaves a space in the centre for the prominences of the two condyles, which is then overlapped by the central flaps. Having notched the pasteboard, it is to be well soaked in boiling water, until it becomes soft enough to mould easily to the shape of the joint. The proper degree of softness can be ascertained, by its becoming compressible between the fingers, and not cracking when it is bent; the softer it is, the better, for it can then be more closely moulded to the shape of the joint. Before applying the pasteboard, a piece of lint should be placed on it and notched as well, so as to guard the skin from irritation, which the roughness of it will produce when it is dry. As soon as the pasteboard is nicely moulded to the joint, it is to be confined in its position by means of a bandage passed upwards from the fingers. If there be any tendency for the elbow to be displaced backwards, the same plan may be adopted as was recommended for the treatment of fracture of the lower end of the humerus; namely, to

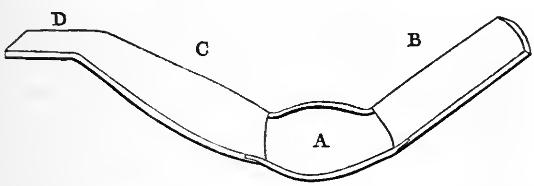
apply a strong splint along the back of the arm beyond the elbow, and another bent at right angles before the joint, in order to prevent retraction. The fore arm should be supported in a sling throughout its whole length from the wrist to the elbow, taking care that the hand does not drop. The application of the sling is different in this case, to either the fracture of the neck of the bone or of the shaft, for in the former kind of injury the elbow is to be the part most supported, while in the latter it is to be allowed to drop, by giving most support to the wrist; whereas in fracture through the condyles, both the elbow and wrist are to be equally supported, so as to remove all strain from the joint. The joint in these cases of fracture through the condyles should generally be confined about three weeks, a longer period is not necessary; for the danger is, that stiffness may remain, owing to the inflammation that has been going on within it, and which might be difficult to overcome if allowed to continue for a length of time. Passive motion only, must be given at first, and should not be continued if it produce much pain, otherwise the inflammation will be brought back again, and more harm than good done.

If the pasteboard splint produce no pain, and if the ends of the bone appear to be in good apposition, it need not be removed for ten days or a fortnight, for the quieter the joint is kept the better, and nothing can be gained by moving it. If, however, the pain should be so great, as to lead to the supposition that the inflammation is increasing, all pressure must be removed, and leeches, &c. applied to the part. Sometimes it becomes necessary to re-apply the pasteboard, on account of the swelling of the joint that may have

been present when it was first put on having subsided; which then causes the splint to be too large and to give no support to the portions of bone; under these circumstances, the pasteboard must be soaked in the boiling water again, and re-moulded to the joint.

Compound fracture of the condyles of the humerus is not an uncommon accident; it is however always a most serious kind of injury, and one that often requires amputation. There are nevertheless many cases that recover, though the joint, in the majority of them, is generally deprived of its free motion, and often no motion at all remains, but anchylosis takes place. The cases of compound fracture into the elbow joint, that recover, are those where the force has acted more indirectly than directly on the part; for the ends of the bone being driven against the condyles and through the soft parts, will do less mischief than a heavy weight coming upon the joint and so crushing them. These cases are very troublesome to treat, on account of the difficulty of applying support to the part, for pressure cannot be borne by making any extension on the limb that at the same time confines the joint. There was a case of this kind in the Middlesex Hospital, about two years ago, under the care of Mr. Mayo. The lower end of the humerus was fractured through the condyles, and there was great injury done to the soft parts around. Inflammation and suppuration took place from large wounds opposite different parts of the joint, so that it was quite impossible to steady the limb by any ordinary kind of splint, that at the same time told against the joint. It became an object then to try and invent something by which the limb could be generally supported, and the pressure of the joint be avoided; to do which Mr. Mayo had the following kind of splint

made, which answered the purpose exceedingly well, by allowing the wounds to discharge freely, and to be dressed without disturbing the limb. It consists of two splints joined together by means of two small bars, so as to leave a space between them for the elbow to fit into. One of the splints, B, in the wood-cut, is made for the back of the arm to lie upon, while the other, C, is for the fore arm, which terminates in a horizontal portion, D, for the hand to rest upon; the intervening space, A, is formed by the two lateral bars, which are slightly curved outwards, to prevent pressure on the joint. When the limb is applied to it, the hand and fore arm must be well fixed to the splint C, D, for then the elbow will be prevented slipping too much into the space A, by the ulna and radius supporting the condyles. Very little constriction will be required to confine the arm to the upper part of the splint.



The above splint would be more perfect by having a hinge placed in the two lateral bars, and to admit of being fastened at any angle that it might be necessary to place the limb in, which will be different according to the precise situation and direction of the fracture. As soon as the soft parts have sufficiently recovered, the above splints may be discontinued, and the common lath splints be applied.

All that can be done in very severe cases of compound fracture of this kind, where it is deemed advi-

sable to try and save the limb, is to keep the patient in bed for some days, and to support the fore arm and elbow upon pillows, the joint being flexed. In some cases, where there is a disposition for the lower portion to be drawn upwards, the patient may be slightly raised in bed, so as to allow the elbow to drop and keep up extension, which will tend to counteract the retraction of the muscles, and is the only mode of doing so until the active inflammation of the joint has subsided, to admit of local pressure being made. The fear of anchylosis is much greater in the compound than in the simple fracture; the joint must therefore have passive motion given to it as soon as the state of the parts admits of it; carefully avoiding, however, all motion if it tend to produce inflammation.

FRACTURES OF THE SCAPULA.

The scapula is less frequently broken than any of the bones of the upper extremity; for it is protected anteriorly by the thorax, and is covered posteriorly by a thick mass of muscles; it also moves upon a large muscle, namely, the serratus magnus, which serves as a cushion to it, and deadens a blow when applied to it from behind. There are, however, some parts of the bone which enter into the formation of the shoulder joint, and form certain prominences that are more frequently exposed to injury than other parts of the bone: these parts are the acromion and coracoid processes; and the former is much oftener fractured than the latter. The spine of the bone lies very superficial, being merely covered by the integuments, and might at first be thought liable to fracture, but it is not often broken, for this part is the strongest, at the same time that the blow which tells upon it, is deadened by the pad of muscle that is placed beneath the scapula. The neck of the bone is sometimes said to be fractured: it is a very rare kind of accident.

The flat part, or body of the scapula, can only be broken by the direct force; for its situation is such, that the indirect cannot be applied to it. The force must also be of a very powerful kind, for the broad thin shape of the bone, and the covering of muscle that it receives, prevents a slight force taking any effect upon it. It is owing to this circumstance, that fractures of this bone are generally of so serious a

nature, for the violence of the force that produces it, often extends to other parts than the scapula, and causes injury to the ribs and viscera within the chest. The fracture, however, not unfrequently remains confined to the bone struck, and does no further mischief. The two following cases illustrate the kind of force that then generally acts :—

Case.—William Beaumont, æt. 43, July 4th, 1835, applied at the Middlesex Hospital, having received an injury on the back part of the shoulder. He stated that he was standing by a scaffolding, when a cart, which he did not know to be near him, suddenly backed upon him, and pushed his right scapula violently against one of the poles. On examination, a bruise was found in this situation, and the bone was found to be fractured just below its spine, the fracture extending obliquely across. The upper portion of bone was tilted upwards, and the lower one dragged slightly downwards and outwards by the action of the serratus magnus. The line of separation could be distinctly felt, owing to the tilting up of the fractured edge of the upper portion of bone.

Case.—Francis Brown, æt. 50, October, 1831, states that he trod on a piece of orange peel that was on the floor, when he slipped and fell backwards, and struck the left scapula against the corner of a table. On examination it was found that the bone was broken, and that the fracture extended obliquely through the lower portion of the bone, so as to include a portion of the spine of the scapula as well. There was not much displacement in this case; but the portions could be easily moved upon one another, and the crepitus be produced at the same time.

If the injury be merely confined to the scapula, its

treatment is very simple, and the patient recovers without any unfavorable symptom; but if it be complicated with fracture of the ribs and other bones, his recovery then becomes more doubtful, and the injury not unfrequently terminates fatally. Fracture of the body of the bone generally occurs at that part of it which is situated below the spine, and extends transversely or obliquely across, so as to separate it into two portions. When the spine itself is fractured, the force must be very great and very smartly applied, at the same time that the brittle structure of this part of the bone is liable to make it comminuted.

The symptoms denoting this kind of injury are generally very apparent, and are discovered by examining the part with the hand. The motion and crepitus are the two important symptoms; and they are to be obtained by fixing the upper portion of the scapula with one hand, while the lower is moved from side to side with the other: without there be much swelling, the bone can always be sufficiently firmly grasped in order to do this. The actual displacement is never very great; for the numerous muscles attached to both the upper and under surface of the bone, will tend to keep the fractured portions from being drawn much apart. The broad portion which looks inwards towards the opposite bone, has many large muscles attached to it, that will keep it from falling much either downwards or forwards. The displacement that generally takes place, I believe to be dependant on the weight of the arm and shoulder, which drop down against the outer portion, and so push it under the other. Care must be taken, in examining these cases, not to mistake the motion of the integuments, which has a great tendency to slide over

the muscles on the dorsum of the bone, for the motion of the fractured portions: and this mistake will be liable to occur, if the portion of bone be not very firmly grasped. Sometimes motion of the upper extremity, produced by raising and depressing the arm, will cause the crepitus, which may be felt by laying the hand flat upon the bone while it is being so moved. To ascertain if the spine of the bone be fractured, it will be necessary to press it forcibly with both hands in opposite directions, when the crepitus may be felt: there is little or no displacement in these cases. When the fracture extends through the body of the bone as well, the upper portion may be tilted so as to project backwards, owing to the weight of the shoulder dragging its upper edge forwards.

TREATMENT OF FRACTURES OF THE BODY OF THE SCAPULA.

The treatment in these cases is very simple, for little can be done in the way of confining the portions of bone; and, generally speaking, the displacement is so slight, that little harm results if the fractured portions unite in the position into which they are driven at the time of the accident. In order to keep the fractured portions of bone in place as much as possible, the whole scapula is to be fixed by swathing the chest with a broad cotton or flannel roller; the last turn or two of which should be made to include the arm, and to bind it firmly down to the chest; so that the muscles attached to the bone may be relaxed, and the scapula itself prevented moving by keeping the arm at rest. If the lower portion has any tendency to fall or to be pulled outwards, a pad may be placed against it, and braced up firmly across the opposite

side of the chest. It is seldom, however, that much advantage can be gained by this : the arm should be supported in a sling, so as to support the shoulder joint, and to prevent the weight of it dragging downwards.

When the fracture is not complicated with other injuries, the union generally takes place in about four or five weeks, not requiring a longer time than the fracture of other bones. The free use of the shoulder joint, however, is not recovered till some time after, owing to the bruising of the muscles and the thickening of the parts round the bone, the confined position of the limb also opposes their early use, and deprives them of their action.

FRACTURES OF THE NECK OF THE SCAPULA.

The shape of the neck of the scapula and its connexion with the body of the bone, are such, that the slightest examination of the part will indicate that its fracture must be of very rare occurrence; for this part of the bone is not only the strongest, but is the most protected from injury. Any force applied to the back or outer part of the shoulder, will be more likely to produce fracture or dislocation of the humerus, than to injure the neck of the scapula; for on the outer part, the neck of the bone is protected by the humerus and deltoid muscle, while on the posterior part, it is covered by a portion of the deltoid, and by the supra and infra spinatus muscles. The only probable manner in which this part of the bone can be fractured, is by the force telling directly on the anterior part of the shoulder joint, so as to strike the coracoid process or the edge of the glenoid cavity ; but even in this situation, it is amazingly difficult for it to act

with sufficient violence, for here the bone is covered by muscle and lies very deep. At the same time that a force when applied in this direction, tends to push the whole scapula backwards, and will be less likely to tell upon the neck of the bone, than if it offered more resistance, by having a more decided fixed point. If the force strike the coracoid process, which it will be more likely to do, than the neck of the bone, this part may yield instead of the neck, owing to its being the weaker of the two. In order for the force to act when applied in any of the above directions, it must be very violently and very *smartly* applied. A likely cause to produce this kind of fracture, is a musket ball, but then of course the fracture must be compound.

The extreme rareness of the fracture of the neck of the scapula, is borne out by there being no specimen of it, that I am aware of, or very few, in any of the museums, while examples are often met with of most other kinds of fracture. Duverney mentions a case, however, of a woman who fell into a stone quarry and was killed on the spot, having bruised the body to a great extent, and broken many ribs. With regard to the state of the scapula, he says, " On examining the left arm, I thought it was dislocated ; I made an incision through the integuments and muscles, and opened the capsule ; the head of the humerus occupied the cavity, but I then discovered the fracture of the neck, and of the coracoid process, which were completely separated from the rest of the bone."*

Boyer remarks, with regard to this kind of fracture and that of the coracoid process, and very justly too, that " although it cannot be denied that the conformation of the skeleton is such, as to make these kinds of

* Traité des Maladies des Os. tome I.

fractures appear very possible, still the deep situation of these parts renders their fracture so difficult, that hardly any examples of it are cited. It requires direct causes of an enormous force to produce this sort of fracture, which are then always complicated with such violent contusions, that they become an evil more serious than the fracture itself."*

In young people the glenoid cavity might be expected to be liable to separation, owing to its not being completely ossified to the rest of the bone ; but in them, a force can seldom act with sufficient violence, owing to the want of resistance in the part, at the same time that it is only the narrow rim of the bone anterior to the root of the coracoid process, that remains unossified, which is the most difficult part of all to fracture.

The symptoms of fracture of the neck of the scapula, which are to be looked for when it does occur, are, flattening of the shoulder, with a depression under the acromion process, which are caused by the neck of the bone dropping by the weight of the arm dragging it down and taking the round head of the bone with it; the coracoid process is found to be lower than natural, for it also is separated with the neck and must go wherever it goes; and if the neck of the bone itself can be felt, which it is difficult to do in fat people, or when there is much swelling present, it will be found to be lower than natural, but still to bear its proper relation with the head of the humerus. I believe, however, that the separation can never be very great, owing to the strong ligaments that connect the coracoid process with the under part of the clavicle. If the separation be anterior to the root of this process (which I think almost impossible), the neck of

* Traité des Maladies Chirurgicales. tome III.

the bone may drop some way, for these ligaments will then have no effect upon it. Fractures of the neck of the humerus very high up, may be mistaken for fracture of the neck of the scapula, and more particularly if the patient be not seen before the swelling round the joint comes on; for the appearance of the shoulder in the two cases may very much resemble each other, for the elbow may drop, and the shoulder may be flattened, owing to the prominent head of the bone being displaced downwards and inwards. This case, however, can easily be distinguished from fracture of the neck of the scapula, by attending to the position of the coracoid process; for if this part be immoveable and in its proper place, the deformity will be dependant on the humerus, and not upon the scapula; for as already stated, it must be next to impossible for the neck of the bone to be separated, without the coracoid process going with it at the same time. That part of the glenoid cavity anterior to the process, no doubt may be *split* by a direct blow upon it, but the symptoms then are quite different, no displacement being produced.

TREATMENT OF FRACTURES OF THE NECK OF THE SCAPULA.

The principle upon which fractures of the neck of the scapula are to be treated, is very simple; namely, to support the elbow well, so as to push the head of the humerus upwards, and to support the neck of the bone at the same time: to do which, there should be a firm pad placed in the axilla as well, underneath the neck of the bone, and braced firmly up against it by the figure-of-8 bandage. The arm is then to be fixed to the chest, and to be kept perfectly quiet, for motion

must be guarded against in this more than in any other kind of fracture, owing to the unfavorable position of the portion of bone, and to the very small surfaces that have to be opposed to one another. Sir A. Cooper says that from ten to twelve weeks are requisite to complete the union.

FRACTURE OF THE ACROMION PROCESS.

The acromion process is the part of the scapula most frequently fractured; for it forms so large a prominence on the upper part of the shoulder, and overhangs the head of the humerus, so as to be exposed to a force which tells from above: a blow directly on the outside of the shoulder will not be liable to break it, for the head of the humerus extends more external to it and would receive the shock.

The process is generally broken nearer to the root than to the apex, and it may give quite at its junction with the spine of the scapula, when the force is applied in this situation, and is of a very violent kind: the direction it takes is generally transverse. In young people the process may be separated nearer to the apex, at the point of junction, when the epiphysis is still unossified; a force, however, is seldom applied in this direction in young people, and they fall with little weight, so as to make this kind of fracture in them very rare.

The most frequent cause of fracture of the acromion process, is by the person falling sideways against some hard resisting body, so as to strike the top of the shoulder as well as the side of it. The following case illustrates the kind of force.

Case.—Helen Nugent, Dec. 8, 1831, a milk girl;

states that she was milking a cow, when the animal pushed her violently, and struck the top of her shoulder against the wall; she was unable to raise the arm afterwards, and applied at the Middlesex Hospital the same day, when the acromion process was found to be fractured, the symptoms of the injury being very evident. The shoulder dropped and the process was depressed with it, and could be raised up again by pushing the head of the bone into its place; distinct crepitus could be discovered, and the sharp edge of the spine of the bone could be felt terminating abruptly.

A heavy weight falling on the top of the shoulder, may fracture the acromion, or it may be broken, but very rarely so, by the head of the humerus being pushed forcibly upwards against its under surface. The force required under these circumstances is very great, and one that at the same time more frequently fractures the humerus itself, or the clavicle. In a young person, fracture might be produced in this way, when the force tells in the above direction. Fractures of this process, however, under any circumstances, are not so common as might be expected, when the part is looked at in the separated, dry bone; for then it stands out so prominently and apparently so unprotected, that a very slight force seems sufficient to break it. When, however, it is articulated with the humerus and clavicle, and surrounded by the muscles, its relation becomes altered, and then it is found that these parts most frequently receive the shock, and that the acromion, in the majority of cases, escapes altogether; for the force that is then applied, if it take effect, still produces either dislocation of the humerus, or fracture of the clavicle.

The symptoms of fracture of the acromion are the

following: dropping of the shoulder, and inability to to raise the arm directly outwards, though it can be brought backwards and forwards; an unnatural depression in the situation of the process, owing to the weight of the shoulder and the deltoid having dragged the fractured portion downwards; a prominence in a part of the spine of the scapula where none ought naturally to exist, caused by the process being separated from the rest of the spine; crepitus, when the humerus is pushed upwards towards the acromion, or when the elbow is brought out from the side. Motion of the fractured portion which can be felt, by placing the hand on the top of the shoulder, and then elevating and depressing the head of the humerus. Finally, measurement will indicate that fracture exists when the process is displaced, for the distance from the root of the spine of the scapula to the prominence that is felt, will be found to be shorter than on the opposite side, owing to the absence of the acromion on the injured side and the presence of it on the other.

The shoulder cannot be said to be flattened in these cases, although it drops, for there is still the round head of the humerus beneath the deltoid, and it is the central portion of the muscle that is only displaced, owing to these fibres that are inserted into the process having lost their support. If the fracture be very near to the root of the process, there will be much more depression of the shoulder, for then the clavicle will fall as well, and so allow of the whole muscle becoming displaced downwards. The motion of the portion of the process will be greater as well, where the fracture is nearer to the root of it, and the crepitus also. I have often succeeded in gaining the crepitus, by raising the arm outwards to the utmost, when simple

elevation and depression of the head of the humerus would not produce it.

In a fat person, or when there is much swelling present, the nature of the accident is by no means easy to discover, owing to the difficulty of feeling the extremity of the process, and of distinguishing the exact point at which the motion and crepitus are produced. I lately saw a case of this kind, where the patient did not apply for relief for two days after the accident: the whole shoulder was then greatly swollen; and it was impossible to say whether any fracture existed, or in what situation it might be, if one were present. As soon as the swelling subsided, however, the acromion was found to be fractured, and to be depressed some way below the spine of the bone.

TREATMENT OF FRACTURE OF THE ACROMION PROCESS.

The treatment to be adopted, is to keep the head of the humerus pressed forcibly upwards against the process, so as to place the acromion on a level with the other part of the spine of the scapula. This is to be done by raising the elbow with a sling, made so as to press against the elbow more than the fore arm, and by allowing the hand to drop, and so to tilt up the elbow and the humerus with it. There is no fear of lateral displacement occurring, for the close insertion of the trapezius and deltoid muscles will guard against this. The process may be steadied by the spica bandage, which is to be applied over the shoulder, and then under the axilla of the injured side, and then across the back and chest under the axilla of the opposite side, and then brought back over the shoulder of the injured side again, and so on till the bandage is

nearly exhausted. The last part of the bandage may be made to pass over the shoulder by the neck, and then under the elbow and lower part of the fore arm, by which any degree of pressure can be made upwards with the head of the humerus, by tightening the portion of bandage that passes under the elbow. The wood-cut represents the bandage when applied.

In some cases there is so much tumefaction present that the bandage cannot be immediately applied; when this is the case, the fore arm must be put into a common sling, made with a handkerchief, taking care to support the elbow and not the hand, so as to tilt the humerus upwards and support the fractured process.

The acromion, when fractured, does not always unite by bone, but often only by a ligamentous substance. This is dependant on the difficulty of keeping the fractured portions in exact and close apposition, and not upon any peculiarity in the situation of the process.

FRACTURE OF THE CORACOID PROCESS.

This is a very rare kind of accident, and one that can only be produced by very violent force directly applied to the part itself, when it is generally accompanied by great bruising and injury to the joint and parts around. Boyer mentions a case where the accident was caused by a blow from the pole of a carriage,

and he states the violence of the shock to have been so great as to kill the man.

The nature of the injury is discovered, by feeling the portion of the process that is fractured displaced downwards and forwards, by the action of the three muscles that are attached to it; there is also motion found when the process is pressed upon, or when the arm is moved from the side. There is no alteration in the shape of the shoulder, any more than the swelling of the soft parts around will account for; for the head of the bone and the rest of the scapula bear their proper relation to one another; and attention to this point will prevent the simple separation of the coracoid process being mistaken for fracture of the neck of the scapula.

The treatment must be very simple, by supporting the elbow in a sling, and bringing the arm close to the side, to relax the muscles attached to the process. No pressure can be borne on the part itself at first, but blood will very likely require to be taken by leeches or cupping, owing to the inflammation that is sure to arise after so severe an injury. Perfect rest is all that is necessary, and attention to the local inflammation,—nothing can be gained by confinement with bandages.

FRACTURE OF THE CLAVICLE.

THE use of the clavicle being to prevent the shoulder falling inwards and forwards, and to serve as a fixed point for the upper extremity to move upon, causes it to be influenced by shocks that are applied to the shoulder joint when violence is communicated to it, either directly by the humerus itself, or through the medium of the bones of the fore arm; the consequence of which is that if these parts are strong enough to resist the force, it tells afterwards upon the clavicle, and very often breaks it.

The shape of the bone, as well as its situation, renders it very subject to fracture; for it is convex anteriorly, and smallest at its most convex part; so that a force applied to it, either obliquely, or from without inwards, will bring more of the strain upon this part of the bone than upon any other. The two extremities of the bone are thicker and stronger than this central part, and are connected to the sternum and scapula by means of strong ligaments, which render them capable of offering much more resistance than the middle of the bone, which has no such support. It is owing to these strong ligaments, that the clavicle is not more frequently dislocated than fractured; which we should expect to be the case by looking at the small articular faces of the ends of the bone in their dried state: these ligaments however are found to possess more strength than the central part of the bone, in the majority of instances, when any force is

applied to the shoulder, and which causes the fracture to occur oftener than the dislocation. The indirect force generally causes the fracture, and is communicated to the bone by falls upon the shoulder most frequently; or by falls upon the palm of the hand, and so driving the humerus and scapula suddenly from their place, and bringing all the stress upon the clavicle: the former way however is the most frequent cause of the fracture. The direct force sometimes produces fracture of the bone, when it is applied so as to tell on the upper or anterior part of it: it is a more serious kind of injury, owing to the bruising of the soft parts that takes place at the same time.

The situation of the fracture, as already stated, is generally at or near the centre of the bone. The sternal or scapular ends are comparatively seldom broken; for these parts of the bone are of a different shape and structure, being thicker and more spongy. The scapular end, however, is more frequently fractured than the sternal; for it is flatter and broader, and very liable to yield by a force directly applied to it. The sternal end of the bone is round and thick, and very capable of resisting a force when applied to it; while it is more subject to dislocation than the scapular end, owing to its ligaments being comparatively weaker. The sternal end of the bone is more likely to be fractured or separated in very young people, in whom the epiphysis is not yet joined by ossific matter. The following is a case of this kind:—

Case.—James Chilton, æt. 3, admitted out-patient at the Middlesex Hospital, August 31, 1835. The father of the child stated that the boy was playing on some steps with some other children, when he fell, and struck the shoulder against the edge of one of

them. On examining the part, the clavicle was found to be fractured at about half an inch from the sternum. The crepitus of fracture could be distinctly felt, and the end of the bone moved from its natural position. The other clavicle had been broken about a fortnight previously. The direction the fracture takes is generally oblique, and in one place only, more particularly when it is caused by the indirect force: and this obliquity is one great reason why it is so difficult to treat this kind of injury without some slight deformity (and often a very great one) existing afterwards. The smallness of the fractured ends of the bone is also one reason, by preventing the surfaces being locked against one another, and allowing the weight of the shoulder to displace them with facility. The fracture is most frequently simple; but it may be compound, when the force is very violently applied, or when it acts directly on the bone. Compound fracture of the clavicle might be expected to occur more frequently than it really does; for the skin covering the bone is so thin, and the fractured ends often so sharp, that it requires great care in many cases to prevent them being driven through it. The reason of the fracture being so seldom compound, I believe to be owing to the force generally telling in a direction that tends to drive the scapular end of the bone (the moveable portion) inwards and backwards instead of forwards; which position takes the point of bone from the skin, instead of pushing it against it. The sternal end of the bone is prevented doing mischief by the shoulder falling forwards and inwards; which position relaxes the skin, and so removes the pressure from it, that the end of the bone might otherwise produce. The vessels and

nerves are seldom injured—for they are protected by the strong fascia, and by the subclavius muscle.

Fracture of the clavicle is a very common accident in young children, the bone in them being so small and thin, and the ligaments comparatively strong, which prevent their dislocation. I believe that fractures of the clavicle in children, will be found to occur more frequently than any other kind of fracture.

The symptoms of fracture of the clavicle are very evident in the majority of cases; the shoulder falls downwards and forwards, the level of the acromion being much lower on the injured than on the sound side. The chest also has the appearance of being narrowed, for the distance between the two shoulders is found to be less, owing to the clavicle being shorter than natural; one portion of the bone is seen to be more prominent than natural, owing to the other being depressed, and it will be almost invariably found that the sternal end is the prominent one, and remains stationary, while the scapular end is the one displaced. I have, however, in one case seen the scapular end of the bone placed anteriorly to the sternal, and forming the prominence instead of it. It was an old fracture, and the ends of the bone had perfectly united in this position. Motion of the fractured portion can be easily produced, by drawing the shoulder backwards and outwards, when the crepitus can generally be got at the same time; as soon as the extension, however, is removed, the bone falls again into the same position, owing to the weight of the shoulder and upper extremity dropping in this direction. The patient also experiences pain on making any attempt to move the limb, and is unable to bring the hand across the chest

to the opposite shoulder; for by so doing, the clavicle is pressed inwards, and being fractured gives no fixed point for the muscles to act upon, but only pushes the end of the bone inwards behind the sternal portion. Sometimes the fracture takes such a direction, that the two portions of bone are locked within one another, and do not become readily displaced; the way to produce the crepitus in these cases, is to grasp the two portions of bone, while an assistant rotates the arm in various directions; during which action, there will generally be found to be more motion in the scapular than sternal end, and a grating of the fractured surfaces upon one another will be produced at the same time. When the bone is comminuted, the least motion produces the crepitus.

One satisfactory result in the treatment of fractures of the clavicle is, that although it is very difficult to prevent deformity altogether existing afterwards, the motion and free use of the limb do not become much impaired; for the bone is often shortened an inch or more, and still the limb possesses free motion and strength. This shortening causes the neck of the scapula to fall forwards, and makes the base of it project backwards, giving the person the appearance of having the chest contracted in front; by which the extent of range of action in the upper extremity will be diminished, although sufficient motion remains for the ordinary uses of the upper extremity. Where the fracture occurs in females, in whose dress the clavicle is exposed to view, it becomes an additional object to get the bone to unite as evenly as possible, to guard against the formation of an unsightly lump that will remain for ever afterwards. The more the deformity is prevented

in these cases, the more credit the surgeon will get for the cure.

The degree of displacement of the fractured ends of the bone, depends more or less upon the point at which the fracture is situated; for it is found that the nearer it is to the centre, the more displacement there will be between them. When the fracture is near to the acromion there is often no displacement, and then the fracture becomes more difficult to discover.

The most common direction for the displacement to take, as already stated, is for the scapular portion of the bone to be depressed behind, and rather below the sternal portion, which position is caused by the weight of the arm and fore arm carrying the shoulder downwards and forwards; so that the upper or sternal portion appears to be tilted up, and to be riding upon the lower, when in fact it remains fixed and almost immoveable, owing to its mode of articulation, and the weight of the shoulder being taken off it. The sterno-cleido mastoideus muscle is by some described as pulling upon, and producing displacement of the sternal portion of the bone. It no doubt has the power of doing so to a slight extent, but I do not think that it ever acts sufficiently in these cases to make it important enough to pay attention to. The pectoral muscles are said to pull the shoulder downwards and forwards: I do not think however that they have much effect in doing so, or in producing the displacement of the scapular portion of bone; for the weight of the arm, and the tendency for the scapula to roll forwards when the clavicle is broken, are sufficient to explain the peculiar position in which this portion of the clavicle is generally found. The force also which causes the fracture,

no doubt acts in many cases, and pushes the one portion behind the other; and the weight of the arm then keeps it there.

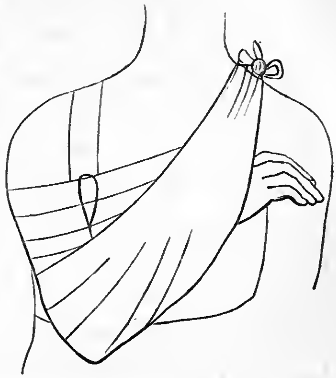
The method of reducing the depressed portion of bone, is by applying a force in a direction the opposite to that in which the force was applied to displace it: thus—the scapular portion of the bone is depressed downwards, inwards, and backwards, being behind the sternal portion. The force then must be applied so as to tell upwards and outwards, and at the same time bring the portion of bone forwards, and there are two ways of doing this: one is by placing the knee against the patient's back, and then pulling the shoulders forcibly backwards, which draws the scapular portion of the clavicle in the same direction, owing to the scapula with which it is connected being pulled round the convex surface of the chest: the portion of bone is drawn outwards by means of a pad placed in the axilla, and then bracing the arm down to the side. The other way of reducing the bone is, by merely placing a thick pad in the axilla, and then pulling the elbow forcibly before the chest, so as to bring it opposite the median line, by which the whole scapula and portion of clavicle connected with it are drawn outwards from the chest, owing to the pad acting as a fulcrum, and the humerus as a lever. The latter is the plan that was first recommended by Desault.

The treatment of making forcible extension on the shoulders backwards, is very good in its principle, as can be exemplified in every case of this kind of fracture, for it will be found to redress the deformity and to bring the fractured portions into apposition; but the difficulty is, to apply any means that shall keep the shoulders back, when once brought into this posi-

tion. The figure-of-8 bandage and straps of various kinds have been invented, which all take hold of the sides and fore part of the shoulders, and act by pulling from behind, and so endeavouring to approximate the two scapula. None of these means, however, gain a sufficiently fixed point to act from, owing to the difficulty of grasping the shoulders with sufficient firmness; the consequence of which is, the bandage yields or slips to a certain extent, and the shoulder falls forwards and causes the bone to ride. More can be gained in these cases by having a good thick pad in the axilla and then fastening the arm to the side, than by the bandage or straps telling from behind.

This great difficulty of keeping the portions of the bone in apposition, induced Desault to adopt the treatment which he recommended, and which certainly possesses advantage over the other method; he, however, makes the application of it by far too complicated, and much more so than there is any necessity for; the same principle is acted on, and a similar advantage gained by a much less complicated method, and by one very easily put into practice. The principle of Desault's treatment was, to make the humerus a lever, and to act upon the scapular portion of the clavicle, by placing a thick pad in the axilla, to serve as a fulcrum; he gained his object by numerous bandages and compresses, but the same result may be obtained by much simpler means, as follows.—Place a firm thick pad in the axilla, of a wedge shape, having the thickest part upwards, and confine it there by means of a bandage passed underneath, and then over the shoulder, and then across the chest underneath the opposite axilla, and back again to the same side; this may be done for two or three turns, so as to fix

the compress firmly and to prevent it falling. The elbow is next to be brought before the chest as far as possible, and to be held there, while a few turns of bandage are passed round to confine it to the thorax ; a sling is then to be applied, which must be made very short, so as to prevent the elbow from falling from the position into which it has been brought,

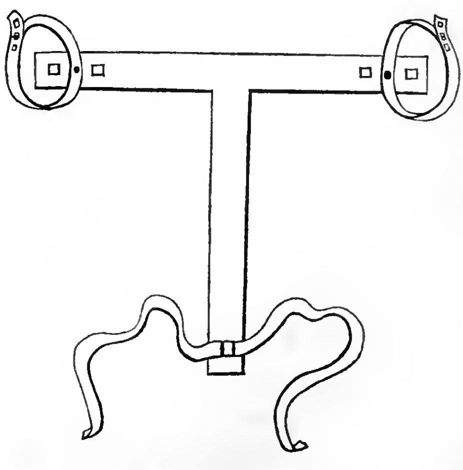


for upon this depends the whole action of the humerus on the scapular end of the clavicle. This simple method produces precisely the same effect as the more complicated one of Desault; for the pad forms the fulcrum, and the humerus the lever, and pulls the displaced portion of bone outwards, as soon as the elbow is brought before the chest.

Nothing is to be gained by applying compresses with the intention of depressing the prominent portion of bone, for, as already stated, it is the sternal portion that projects, which is immoveable and therefore cannot be acted on in this manner. The compresses, or a pasteboard splint, may be of use to protect the integuments from the pressure of the bandage or sling, when the end of the bone is very sharp, or when the fracture is comminuted. When the fracture is compound, the general principle of the treatment is the same, for no pressure need be made upon the wound itself, but the compress may be placed in the axilla, and the elbow brought before the chest as usual by the sling.

Heister recommended an apparatus for fractures of

the clavicle, that I think might be employed with much advantage in some cases, where very great extension is required. It consists of two pieces of board fastened together, in the shape of the letter T, the transverse piece being placed across the shoulders, and the vertical one down the back. To either extremity of the transverse bar, there is attached a hoop of elastic metal, which is meant to grasp the shoulders, and fastens by a small button. The hoop can also be moved inwards or outwards, as may be requisite, according to the width of the patient's shoulders, by having two or three holes made in the extremity of the transverse bar, and passing a screw through them. The vertical part of the splint is steadied by a piece of bandage passed through a hole at the bottom of it, and then fastened round the waist.* The wood-cut represents the kind of splint.



The length of time necessary to confine the limb in the fracture of the clavicle, is not so long as in some other bones, without there be much riding of the por-

* Heister, Institutiones Chirurgicæ. tomus I.

tions of bone. Three weeks, as a general rule, will be sufficient to keep the arm in the fixed position above recommended, and in children a less time is often only necessary; I have seen many cases in which the bone has become firm enough at the end of a fortnight, to allow of the arm being used; in an adult, however, a longer time is necessary, and the arm must be supported in a sling after the confined position is discontinued. Care must be taken at first, to avoid all movement of the limb that tends to press or pull much upon the shoulder joint, the fore arm and hand being moved more than the arm.

The flat portion of the clavicle that is immediately articulated with the acromion, is liable to fracture, and from its situation and absence of displacement may be overlooked.

The causes that produce fracture of this part of the bone, are generally forces directly applied upon the shoulder, such as a heavy weight falling upon it, or it may be fractured by a person falling on the outside of the shoulder, but then as already stated, the centre of the bone is more likely to break. The nature of the injury, when it occurs so near to the acromion, is by no means easily ascertained, for there is seldom much displacement, and often no pain, or impediment to the motion of the shoulder. I remember seeing the case of a boy who broke the clavicle in this situation, while playing at leap frog; he complained of slight pain, and could move the arm about quite as well as if he had received no injury, indeed so little inconvenience did the boy suffer, that it was no easy matter to persuade either him or his parents that the bone was broken. The fracture, however, was quite distinct, when the fingers were placed on the acromial

end of the bone, at the same time that the shoulder was alternately raised and depressed, a distinct crepitus was then produced, and motion felt in one portion of the clavicle without the other. The nature of the injury was further confirmed when the union took place; for then a distinct ring of callus could be felt at about an inch from the acromion process. When the fracture has been caused by the direct force, there may be so much bruising and swelling over the bone, that it is difficult to discover the exact seat of the fracture.

There are various reasons assigned for the absence of displacement in fracture of the acromial end of the clavicle:—some say that the trapezius muscle prevents the portion of bone falling; others give importance to the ligaments that pass up from the coracoid process to the under part of the clavicle; and this latter, no doubt, is a more probable cause than the former. I believe, however, that a great deal depends upon the ends of the bone themselves being more directly locked together, when the fracture is in this situation, than when it is near to the centre of the bone; for now the fractured surfaces are broader, and the weight of the shoulder tells more directly against them, and in a direction not likely to displace them, owing to the fracture being so near to the scapula. Another reason, I believe, is, that the deltoid muscle pulls the sternal end of the clavicle, and keeps it on the same level with the other portion; for as the shoulder drops, and takes the acromial end of the bone with it, the deltoid muscle will at the same time pull upon the sternal portion, and depress it equally as much.

The most sure and decisive symptom of fracture of the acromial end of the clavicle is the crepitus, for it

can generally be produced when the motion of the portion of the bone is not sufficiently marked to be depended on. But then it becomes a question, whether the motion and crepitus are produced by a fracture in the clavicle, or in the acromion process: and this may be difficult to decide where the person is fat or where there is much swelling present. If the person be thin, the acromial end of the bone can be easily felt, by passing the finger along the posterior margin of the clavicle, until it comes to the angle formed by its junction with the spine of the scapula: the fore-finger is to be placed on this part of the bone, and the thumb upon the acromion process. The arm must then be rotated in various directions, and brought outwards into a state of abduction; during which, the fractured portion of bone will be moved, and it can then be ascertained in which bone the motion exists. It is said that this kind of fracture may be mistaken for dislocation of the end of the bone; the two injuries, however, are easily distinguished from one another; for the prominence in the dislocation is much greater, and the measurement of the bone in the two cases is different; for in the dislocation, the length, from the sternal end of the bone to the prominence, is the same as the length of the sound clavicle of the opposite side; but in fracture, the distance to the prominence is less, owing to the acromial end of the bone being removed. Measurement, however, in the majority of these cases is of little use, owing to the absence of displacement, which prevents there being any prominence to measure from. The treatment of fracture of the acromial end of the clavicle, does not differ from that of fracture in other parts of the bone; it generally being requisite however to apply less force,

owing to the little tendency there is to displacement. A pad may be placed in the axilla, and kept there by the common figure-of-8 bandage; and if there be any displacement, Desault's position may be adopted. In the majority of cases a sling alone is all that is necessary, by keeping the elbow from dropping. A fortnight or three weeks is long enough to confine the limb in young people, and a week longer in adults; for motion of the shoulder has less effect upon this part of the bone, than in fracture near to the centre.

FRACTURES OF THE BONES OF THE FACE.

The bones of the face are liable to fracture like other bones, but there are only a few of them that admit of any particular treatment being applied; namely, the ossa nasi and the inferior maxillary bone. The other bones of the face, from their situation and structure, can only be fractured by a force that at the same time crushes the soft parts around, and does great mischief very often to the deep-seated parts as well, so that the injury to the bones becomes of comparatively little consequence.

FRACTURE OF THE OSSA NASI.

The bones of the nose stand out and form so prominent a feature of the face, and are of so thin and brittle a structure, as often to yield and fracture when a force is applied to them. They can, however, offer much greater resistance than might be expected from looking at them in their separate state; owing to their mode of insertion into the os frontis and superior maxillary bone, and to the support they receive at their under part from the septum formed by the ethmoid bone and central cartilage. The force must always be directly applied to cause their fracture, and the most frequent kind is a blow from the fist, or by a person falling and coming in contact with some hard substance; the consequence of which is, that the soft parts around are often very much bruised, and not unfrequently wounded so as to render the fracture compound.

The characteristic symptom of fracture of the ossa nasi is, the displacement that takes place, causing the shape of the nose to be greatly altered, and producing a deformity that it is difficult, and sometimes impossible, to prevent. The extent of the displacement depends upon the degree of force applied, and there is always some present, though it may be very slight; for it is next to impossible for so small a bone to be fractured without some displacement taking place at the same time.

It is said to be more common for one bone only to be broken, than for both together to be the seat of injury, and this I believe to be generally the case, for one may be broken and the other only depressed, so giving the appearance of both being fractured. It matters very little, however, whether both are fractured or not; for it generally happens that they are pushed sufficiently from their apposition to require them both to be reduced. The fracture sometimes extends through the nasal process of the superior maxillary bone; when this is the case, the nasal duct is liable to become inflamed, and not unfrequently lays the foundation of fistula lacrymalis. Ecchymosis and swelling generally come on after this kind of injury, extending to the eyelids; this, however, must not be taken as a symptom of fracture, for it often exists from a simple bruise on this part. The crepitus is not present as a constant symptom, for it is not always that it can be produced, owing to the portions of bone in some cases being so firmly jammed in their new position, and the shape of the part being so unfavorable for taking a firm hold upon it, in order to produce motion. When the fracture is much comminuted, motion can easily be given by holding the nose between the finger and thumb and

pushing it laterally. Very often, when only one os nasi is fractured, there is sufficient deformity to indicate fracture, although no motion or crepitus can be produced; for it almost always happens, when the bone of one side is fractured, that the opposite one becomes displaced, owing to the force in these cases telling sideways, and breaking down the septum at the same time, when of course the other loses its support, and is depressed at the same time.

Since the bones of the nose are found to be driven so forcibly in when fractured, some difficulty might be expected to be met with in reducing them; and this is found to be the case, for in some instances it is almost impossible to replace them completely, so as to prevent deformity existing afterwards. When the force has been applied laterally, the reduction is much easier than when it tells more vertically on the anterior part; for in the latter case they are driven more inwards than in the former, and are at the same time more locked together. The comminuted fracture is also more easily reduced, for the fractured portions are more moveable. The best way of performing the reduction, is to pass a strong probe, or narrow piece of wood, up the nostril, having previously wrapped a piece of lint round it; and when opposite to the depressed portion of bone, to use it as a lever, by placing the fore-finger of the left-hand upon the upper lip, and then resting the elevator upon it, and depressing the other end with the right-hand; the portion of wood in the nostril may be raised gradually, or by small jerks, which latter kind of force often succeeds in moving the depressed portion of bone, when the former will not. In many cases, a pair of long-bladed

forceps may be employed with advantage, by passing one blade up the nostril and the other external to it, and then grasping the depressed portion between the two, and raising it up.

The introduction of pledgets of lint and compresses into the nostrils with the idea of preventing the bones falling inwards, is of no use, nor can they be when it is considered how the portions of bone are locked together, both before and after they are reduced. Petit remarks, "These plugs are only of use to contain the medicaments; and those who have thought of putting plugs of lint with the idea of supporting the bones, for fear they should be displaced, have never made the reduction of a single fracture of the nose: experience would have taught them, that it requires more force to depress these bones that have just been replaced, than was necessary to raise them up with the elevator."* All that can be done, is to replace the portions of depressed bone as much as possible, by the means above recommended. Compresses are not required externally any more than internally, and for the same reason, namely, the difficulty of the portions moving laterally, owing to their being so tightly locked together and preventing displacement taking place. If, however, the bone be much comminuted by the fracture, the portions may be more moveable and require some lateral support, which may then be gained by small compresses, one placed on either side of the nose, and keeping them there with broad straps of adhesive plaster.

Fracture of the nasal bones is sometimes attended with emphysema round the eyelids and forehead, this

* Traité des Maladies des Os. tome II.

is often dependant on the fracture extending upwards, so as to include the frontal sinuses; it is sometimes produced by the wound in the cellular tissue external to the nose communicating with the air cells within, owing to the mucous membrane lining the nostril being torn as well. The brain sometimes receives a shock at the time of the accident, and the æthmoid bone may be driven up into the skull, owing to the nasal bones being depressed inwards and upwards, these cases occur where the force has been very violent, and are to be treated on general principles; the fracture of the bones of the nose, in the majority of instances, being the least important part of the injury.

It is very common for the patients to suffer from head-ache and general febrile excitement, after this kind of fracture; when this occurs, the symptoms must be treated on very general principles, by applying leeches to the forehead and nose and by taking away blood generally, if necessary. The local applications must be made according to the state of the soft parts, making use of cold lotions, or poultices, as circumstances may require.

It sometimes happens that the lacrymal sac or nasal ducts are injured at the time of the fracture, when this is the case, the part inflames, and the sac or duct may become obliterated, ultimately causing the fistula lacrymalis. Duverney mentions a case in which fistula lacrymalis followed fracture of the os nasi, and where cancerous ulceration took place and killed the patient.

If the fracture be compound, the edges of the wound are to be brought together by adhesive plaster, after the bones have been reduced as far into their proper

place as circumstances will admit of: the wound is to be attended to like any other wound, taking care that matter does not collect beneath the skin. It is not uncommon for a portion of bone to exfoliate after the compound fracture, and so causing a permanent deformity in the shape of the nose.

FRACTURE OF THE INFERIOR MAXILLARY BONE.

THE lower jaw is divided into three parts, namely, the ramus, the base or body of the bone, and the symphysis. The ramus is the ascending portion, which terminates in the coronoid process and condyle; the base is the horizontal portion, that descends to meet its fellow from the other side; and the symphysis is the junction of the two portions in the median line of the bone.

The shape of the bone and its situation render it very liable to fracture, when struck a smart blow with any hard substance. When the bone is looked at laterally, there will be seen to be two points of resistance in it, the one is at the condyle, where it is articulated with the temporal bone, the other is at the symphysis, where the two portions of the jaw join in the centre. Between these two points then, there is placed a large portion of bone receiving no support, further than its own structure gives it; so that a blow when applied to this part very violently, between the symphysis and the condyle, will be very liable to break it; and it is found that the fracture generally takes place from a blow striking either the ramus or the base of the bone. The base is found to be the part that most frequently yields, and then the symphysis, and least frequently of all, the ramus. The symphysis is not however very often broken, except by a very violent force, and one applied directly to this part. Some are of opinion that fracture

of the symphysis never occurs, but that it generally takes place to one or the other side of it. Boyer says: "Never does fracture take place in the central point of the length of the jaw, called the symphysis of the chin; but when the solution of continuity occurs towards the middle part of the bone, it is upon the one or other side of this symphysis, which remains always on one of the fragments."* My own experience is certainly opposed to this assertion; for I have seen no less than three cases where the bone was fractured exactly at the symphysis, extending vertically downwards, between the two middle incisor teeth. It was a case of this kind, that induced me to invent an instrument that I shall presently have to speak of, for the treatment of this injury. One of the cases in which I have seen the symphysis broken, was a child about ten years old; and at this age we should expect this part of the bone to yield rather than any other.

The fracture of the base of the bone may be either single or double, simple or compound. The double fracture is not very common; for when the bone is broken at one part first, the force does not tell with sufficient violence on the remainder of the bone to break it in a second place: a crushing kind of force, however, that tells on both sides of the jaw at once may fracture it in two places. The force required to fracture the bone in any part must be very great; for the mode of its articulation with the skull, and its junction at the symphysis, give it great power of resistance. The most common causes of the fracture, are a blow from the fist, or a kick from a horse, or by the person falling against any hard body. The direction the fracture takes may be either vertical or oblique:

* Traité des Maladies Chirurgicals, tom. 3.

the former is the most frequently met with. It is said sometimes to extend horizontally; but I have never seen an instance of this kind myself, where any very large portion of the bone has been separated from the rest in this manner. It generally happens that the alveolar processes only in these cases are broken away, leaving the greater portion of the jaw perfect.

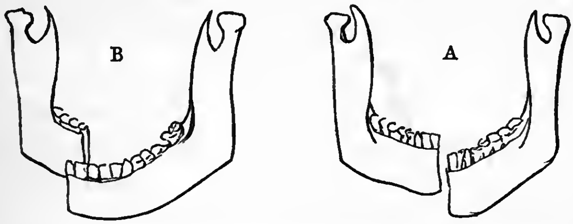
The soft parts near to the bone are often injured to a great extent, causing irritation to the glands in the immediate neighbourhood of the mouth. I remember seeing a case where so much irritation was produced, that the sublingual glands became immensely swollen, so as to push the tongue against the palate, causing the patient's breathing to be obstructed, and great difficulty in swallowing any substance, even in the smallest quantities. Inflammation often comes on, producing abscess in parts near to the fracture, and in the lymphatic glands of the neck and face. Sometimes the bone is splintered at the time of the fracture, or a small portion becomes carious afterwards, causing exfoliation to take place before the part will unite: the abscesses that form in these cases are often very tedious and difficult to cure.

Fracture of the lower jaw is, in the majority of cases, easily discovered; for the symptoms are generally very apparent, and the situation and shape of the bone admit of it being easily examined. Frequently the displacement of the portions of bone is such as to present a marked irregularity when the finger is passed along its under surface, rendering the nature of the accident evident at once. Another symptom is the irregularity of the teeth, for it will be found that they are higher in one part than another, owing to the portion of bone

being raised to a higher level, at the same time that lateral displacement exists, owing to the pterygoid muscles acting and pulling the smaller portion of bone inwards. Sometimes there is little or no displacement, and the swelling of the part is so great, that no irregularity can be discovered along the lower margin of the bone;—in these cases, the bone must be examined with the hand, and attempts made to move one portion upon the other, by pushing them in opposite directions, at the same time that the level of the teeth is looked at, to see if any separation takes place. Generally speaking, a very slight motion between the fractured portions is sufficient to indicate the situation of the fracture: crepitus is not produced without the fractured surfaces are rubbed upon one another to some extent, which in many cases is difficult to do. It often happens that the portion of gum immediately opposite the fracture looks redder than natural, and is torn through. This may be useful as a symptom where the displacement is not great, as leading to point out the probable situation of the injury. When the injury exists in the ramus or angle of the bone, the symptoms are not so evident; for the displacement is less, and the part does not admit of such easy examination. Combined with the above symptoms, there is generally pain and inability to move the jaw, and if the displacement be very great, the speech becomes affected, owing to the difficulty of moving the tongue.

The kind of displacement that most commonly occurs, when the fracture is through the base of the bone, is for the anterior or larger portion to fall downwards and forwards, which it will do by its own weight and by the action of the hyoid muscles; while the posterior or

smaller portion, is drawn upwards and inwards by the action of the masseter and pterygoid muscles. The position of the bone in these cases is represented at B.



In fracture of the symphysis, there is separation between the two portions, and one is drawn below the other, as represented at A, by the action of the muscles which pass up from the os hyoides to the chin.

It not unfrequently happens that one of the teeth is driven from its socket and pushed between the portions of bone. I once saw a case of this kind, of a woman who had the jaw fractured by a blow from a poker;—there was great difficulty in getting the two portions to lie in apposition, and the cause was not discovered till two or three days after the receipt of the injury; when, on passing a probe down, a tooth was felt jammed between the fractured surfaces: as soon as it was withdrawn, the ends of the bone came easily into contact. It is proper in all those cases, where the teeth are displaced so as to prevent the direct apposition of the two portions, to remove them with the common tooth forceps. Sometimes the alveolar processes are splintered just at the edge of the fracture, when this occurs, the splinters should be removed, as they will produce inflammation if left in, and ultimately have to exfoliate.

Fracture immediately below the condyle may occur, but it is a very rare accident. Desault mentions two cases in which the fracture was caused by a blow given

on the anterior part of the bone, and so driving the condyle forcibly backwards. Fracture of the coronoid process of the jaw is very rare, owing to its lying so deep, and being covered by the temporal muscle and zygomatic arch; and when broken it cannot be much displaced, owing to the muscle being so intimately attached to it, and its insertion going some way down the anterior margin of the bone, which cannot be torn through by the kind of force that acts, and so will tend to keep the portions of bone in their place.

Fracture of the lower jaw, in the majority of cases, is easily reduced, even when the original displacement has been very great. The most difficult cases to reduce are those where the fracture is far back, and where the one portion is very much drawn inwards: for not only do the muscles generally act more strongly, but the bone itself is not so easily grasped; and consequently so much force cannot be employed as when the injury is situated more anteriorly. In order to reduce the fracture, the bone must be grasped by passing the thumbs into the mouth, and resting them one on either portion of bone, and then placing the fingers underneath the base, or at the angle if the fracture be far back. Motion is then to be given to them by pulling them apart to unlock them, and afterwards in a line to bring them into apposition.

TREATMENT OF FRACTURE OF THE INFERIOR MAXILLARY BONE.

The common method of treating this kind of fracture, consists in fixing the lower jaw forcibly against the upper, either directly, or by placing two pieces of cork between the teeth, and then applying a bandage tightly under the chin and over the top of the head. The

pieces of cork are often of great use, by enabling the two portions of bone to be brought in a line with one another, when simple approximation of the teeth will not do it. They should be large enough to embrace two of the teeth, and be slightly grooved to prevent their slipping off. The pressure to keep the lower jaw fixed against the cork, is gained by passing a bandage under the chin and over the top of the head. The bandage employed for this purpose is called the four-tailed; it may be made of a piece of common leg roller, split at either extremity, for the extent of four or five inches; the centre of the bandage is to have a slit made in it, sufficiently large to admit the chin. Before applying it, it is well in most cases, where the tendency to displacement is very great, to mould a piece of pasteboard to the shape of the lower jaw, by soaking it in boiling water, and then notching it to make it lie flat upon the chin. The pasteboard forms a case to the bone, and makes the bandage press more generally than it would do without it. When the bandage is applied, the chin is to be fitted into the central hole, and the two ends are to be brought up on either side of the head; and when opposite to the ear, the anterior of the four tails are to be tied at the back of the head, and the posterior ones carried upwards behind the ear, and tied on the top of the head: by this means the bandage is more pulled upon, and takes more effect upon the jaw. The wood-cut represents its application.

When the bandages and pasteboard splint are thus applied, the lower jaw is immoveably fixed against

the upper. The patient is unable to talk, and should not be allowed to make the attempt. He is also unable to take any food but liquids, such as broth, beef-tea, &c.; and he requires to be fed with very small quantities at a time, owing to the small space that is left between the teeth: and in some cases it is necessary to keep the lower and upper jaw so close together, that it is very difficult to give the patient any food at all. It will be necessary to keep the two jaws fixed in this manner for a fortnight or three weeks; after which, the bandage may be discontinued, but the patient must for some time avoid talking much, or taking any food that requires the muscles of mastication to be employed.

The above is the treatment that is ordinarily made use of, when there is much displacement present; and in the majority of cases, by a careful application of it, it succeeds very well. It is at all times, however, a very clumsy method, and one that often requires a great deal of trouble to apply it; and in some cases fails altogether in keeping the portions of bone in apposition. I would make the following objections to its employment:—1st. In fractures by the molar teeth, the one portion of bone is often so much pulled upon by the action of the pterygoid muscles, that great displacement is produced inwards, and which the pieces of cork often cannot overcome. 2nd. As the position of the fractured portions of bone depends upon the pressure that is made to keep the lower jaw fixed against the upper, the least loosening of the bandage, or extra action of the muscles, will be liable to disengage the pieces of cork, and to destroy the apposition of the ends of the bone. 3rd. The necessity for keeping the lower jaw so firmly pressed against the

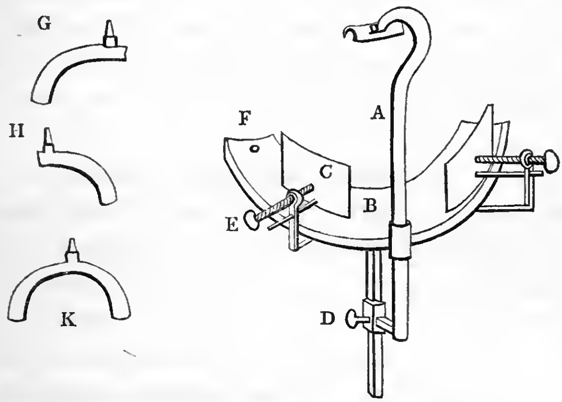
upper, is very uncomfortable and irksome to the patient, by preventing him taking his food, or attempting to talk; which becomes very tedious when it has to be continued for a fortnight or three weeks. These evils, which are met with in a greater or less degree in all cases of fracture of the lower jaw, led me to consider if some kind of instrument might not be invented, by which many, if not all of them, could be guarded against. The objects I had in view were the following:—To apply all the force and pressure to the lower jaw alone;—to fix the two portions of bone between two parallel forces, by applying one on the teeth, and the other under the base of the jaw;—lastly, to keep, the two portions of bone on the same vertical plane, by fixing them in a grooved plate, placed along the teeth. These objects I gained by inventing the kind of instrument that I shall describe immediately.

Fracture at the symphysis of the jaw is, perhaps, the most difficult kind to treat; and the following is a case of this kind, in which the ordinary means were of no avail at all, and for which I was led to contrive the instrument that I have now to recommend for the treatment of this kind of injury.

Case.—John Tomlinson, æt. 60, admitted into the Middlesex Hospital, May 1832; states that he was standing on a ladder, cleaning a window, when the ladder broke, and he fell about fourteen feet; during the fall, he struck the lower jaw against one of the spokes of the ladder, and fractured the bone exactly at the symphysis, the separation being between the two middle incisor teeth. He was otherwise severely hurt, having fractured the fore arm, and received bruises in various parts of the body, of which he ultimately died. The position of the fractured por-

tions of the lower jaw, was like that represented at A, page 229; the one being drawn below the other for some extent. Attempts were made by the usual means to keep the ends of the bone in apposition, by placing pieces of cork between the lower and upper jaws, and then making pressure against them, by the pasteboard splint and four-tailed bandage, the two adjoining teeth on either side of the fracture were also fastened together by means of wire; none of these, however, were sufficient to keep the portions of bone at rest, for the least attempt at deglutition, or motion of the tongue put the hyoid muscles into action, and pulled the ends of the bone apart and below one another. Meeting with this difficulty, and finding the usual means of no avail, I had the following instrument made, which answered the purpose exceedingly well, by keeping the portions of bone at perfect rest. I have since applied it in numerous cases, and with complete success. It consists of a plate of ivory, which is grooved to fit on to the teeth, and is attached to a vertical bar, marked A in the wood-cut, which passes down about two inches below the chin, and is curved at its upper part to prevent pressure on the lower lip. On this vertical bar is made to slide a piece of wood, shaped to the base of the jaw, and marked B, which is pushed up and down by means of a slide, that passes through a small bar, D, which projects backwards from the lower end of the vertical rod, and is capable of being fixed at any level by a small screw, which turns against it. There are also two plates, C, attached to the under part of the chin-piece, B, to make lateral pressure against the sides of the jaw, which they will do by turning the small screw, E. These lateral plates move upon a pivot placed under-

neath the chin-piece, to allow of their being brought nearer to the symphysis, or angle of the jaw as may be required; they are fixed by means of a small screw which turns against them; there is a hole, F, placed at either end of the chin-piece, to pass a bandage through, to steady the whole instrument.



The grooved plate which is attached to the vertical rod, A, in the wood-cut, is meant for fracture of the symphysis; but there are two other plates which fit into the same place, and are marked, G, H, in the wood-cut, which are to be employed when the fracture is to one side; making use of G when the fracture is on the left side, and of H when it is on the right, and should the fracture be double, the grooved plate, K, may be employed.

The instrument is applied as follows:—The grooved plate is to be fitted on the teeth (the portions of bone having been previously brought into apposition), and the chin-piece, B, is then to be pushed up on the vertical rod, A, until it presses firmly against the base of the jaw, and is then to be fixed by turning the screw, D. The bone will now be confined between

two parallel forces, namely, the grooved plate which presses on the teeth, and the chin-piece which presses under the base of the bone; the portions cannot be displaced backwards or forwards, on account of the groove which grasps the teeth. The lateral plates, C, are employed by turning the screw, E, before the vertical pressure on the teeth is quite completed; and when they are placed against the sides of the bone, the fractured portions cannot fall apart and the whole jaw is firmly fixed, and quite independent of the upper jaw.

The first instrument I had made,* consisted merely of the two horizontal plates, I have since added the lateral ones, and have tried it in many cases. The instrument produces no inconvenience, but gives great support to the jaw; and so much so, that some patients on whom I have tried it, have expressed a wish to have it re-applied, after it has been discontinued on account of the fracture having sufficiently united.

The advantages gained by the above instrument, appear to me to be the following:—1st. It is applied with much greater facility, than the method of bandaging and using the pieces of cork, and when once applied there is no fear of further displacement. 2ndly. The apparatus is applied to the lower jaw alone, which gives the patient great ease, and saves him from the necessity of keeping the mouth forcibly closed for so long a time. 3rdly. The motion of the lower jaw is not impeded by it, so that the patient can take his food with facility, and can talk without fear of displacing the portions of bone, by which the cure is rendered much less tedious and irksome than by the ordinary method.

* Vide London Medical Gazette, vol. xi.

The cases in which the instrument is not applicable, are those where the fracture is situated very far back, being through the angle or ramus of the jaw; but then these cases are seldom accompanied with displacement, and do not require mechanical confinement. It is not necessary to remove the instrument so long as it gives the patient no pain, and the portions of bone are in contact. It will be requisite now and then to remove it, in order to clean the upper part of the rod, which gets dirty from the food and saliva collecting there; but this causes no harm to the fracture, as the portions can be held by an assistant, if there be any disposition for them to fall apart.

There are many cases of fracture of the jaw which require little or no mechanical violence to confine them: in these, the above instrument is not necessary; and the common four-tailed bandage and pasteboard splint answer every purpose.

FRACTURES OF THE BONES OF THE TRUNK.

UNDER this head I shall consider the fractures of the sternum, ribs, and pelvis, omitting those of the spine; for when the vertebræ are broken, nothing can be done for the fracture itself: it is the injury of the spinal marrow that then becomes the important point to attend to—that of the bone being comparatively the least serious part.

FRACTURE OF THE STERNUM.

When the sternum is looked at in its separated state from the ribs, it appears capable of offering very little resistance to a force when applied to it; nor would it be, were it only connected at its two extremities by means of the clavicle and seventh rib; but it receives support from the six upper ribs as well, which gives the bone great strength, by adding so many additional points of resistance. Another reason of it not being more frequently fractured is, the elasticity of the cartilage of the ribs, which is the part that joins the sternum, so that when a blow comes upon the bone, it yields to a certain extent, and so deadens the shock, and often prevents fracture which otherwise might take place. It is on this account that a much slighter force will fracture the sternum in old people than in young; for in old, the elasticity is lost, owing to the cartilages having become ossified; while in young people this elasticity remains, and gives both the sternum and ribs

an immense power of resisting fracture, of which the following case is an example :—

Case.—Ebenezer Chapman, æt. 15, was brought to the Middlesex Hospital, May, 1832. Stated that he was leaning against a post, when a cart that was near suddenly backed upon him, and squeezed him violently between it and the post, the whole force of the wheel coming against his chest. He was admitted into the hospital a quarter of an hour after the accident, with the following symptoms :—countenance and lips pale, surface of the body cold, pulse scarcely perceptible; emphysema of the head, neck, and upper part of the chest. The circumstance of the emphysema existing to so great an extent, led to the supposition of the ribs or sternum being fractured; but this was not the case, for on carefully examining the chest, no fracture could be any where discovered. The boy was bled largely, as soon as the pulse got up, and was otherwise treated for a wound of the lungs; the emphysema, however, continued to increase, and the breathing to become more difficult and oppressed, and he died on the fourth day after the injury. On opening the chest, after death, the pleura was carefully traced throughout its whole course, over the ribs and lungs, but no wound could be found in it; nor were the ribs or sternum fractured. Attention was then directed to the air passages, when on laying open the trachea, it was found to be ruptured just at its angle of bifurcation into the bronchi. This of course explained the emphysema.

The above case is exceedingly interesting on account of its rareness, and for the example it affords of the degree to which the thorax will yield to pressure in young people, without fracture taking place. The rupture of the trachea is to be explained, by supposing

the pressure of the cart-wheel against the sternum to have been so great that the bone was driven back against the spine, and so compressed the trachea and lungs at the same time, which drove the air from them, and, not finding any escape, tore the trachea in the part described.

The symptoms of fracture of the sternum are, shortness of breath, with a sharp pain in attempting to inspire; which is owing to the pleura being injured and inflaming, and to the two portions of the sternum not moving together, but one rubbing upon the other, when the ribs are raised or depressed. Spitting of blood may be present, when the force has been very violently applied, so as to wound the lung at the same time. Palpitation of the heart is also often produced. The most decisive symptom is motion between the fractured portions of bone, which can generally be felt by placing the hand flat on the bone, or the fingers of one hand on the upper portion of bone, and those of the other on the lower portion, and then pressing forcibly upon them; or by telling the patient to draw a deep inspiration; during which, the fractured portions will be felt to move irregularly, and to produce a crepitus. Sometimes pressure made laterally on the ribs will produce it, by making the sternum start forward, and causing the fractured surfaces to grate upon one another. The act of coughing often moves the portions of bone, when simple pressure will not. Combined with these symptoms, there is generally a sharp lancinating pain opposite the point of fracture; which is at first confined to the seat of the injury, but soon spreads to the adjacent parts, causing the difficulty of breathing to increase, and to become greater as the inflammation spreads to the pleura; for this membrane

is equally liable to inflame when the sternum is fractured, as when the ribs are.

In fractures of the sternum, it sometimes happens (though rarely, I believe) that displacement of one portion of the bone occurs, owing to the force depressing one below the other. This is not likely to be the case, however, without the violence of the force has been very great indeed; for the shape of the thorax and the elasticity of the ribs, will tend to keep the two portions of bone upon the same level, and to prevent their riding upon one another. When the depression does take place, it cannot always be felt; for swelling may come on opposite the fracture, and prevent it being discovered. It always increases the danger of the patient, for it necessarily implies that great violence has been applied to produce it. Sometimes the bone is driven so much in, as to wound the heart and lungs; Petit and Duverney mention two or three cases of this kind.

The most frequent situation for the fracture to occur in, is in the long central portion of the bone, or at its junction with the upper triangular portion, for this is the weakest part, on account of its thinness. The triangular portion itself is seldom fractured, for it is thick and strong. The xiphoid portion of the bone can only be fractured in very old people, for it does not become ossified till late in life. It is a very rare accident, and of a most serious nature, owing to the viscera beneath it being liable to injury at the same time.

Fracture of the sternum is sometimes compound, where the force has been of a nature to lacerate the integuments: in these cases the situation and direction of the fracture can be easily ascertained, for the finger

can be passed into the wound, or a probe, and the line of separation traced, more particularly if there be any depression of the one portion below the other. The bone being exposed, always makes the injury of a very serious nature, owing to the liability of the surface of it to become carious, and to produce suppuration internally; or else to keep up an open wound that it may be difficult to heal. In the simple fracture, also, where the bone does not unite readily, suppuration may take place either beneath the bone, in the anterior portion of the mediastinum, or else externally, beneath the integuments: the latter is much the less evil, and is more easily discovered and remedied. The practice recommended in these cases, by some, is to apply the trephine, when the matter is beneath the bone, and to let it out. It is an operation, however, not to be recommended; for the symptoms denoting the presence of the abscess, when completely confined to the under surface of the bone, will be very uncertain; and when the matter collects in larger quantities, it will shew itself at the margin of the sternum, between the ribs; when it can be let out by making a puncture with the point of a lancet, without the necessity of removing a portion of bone.

It must be remembered that the formation of matter after fracture of the sternum, will most likely take place between the pleura and the bone, and not between the two pleuræ, as it does in the empyema after fracture of the ribs; for in the latter case the membrane adheres more closely to the bone, and becomes more injured, and often takes on most active inflammation; whereas, in the former case, the cellular tissue is the part the most likely to inflame, and matter may form without the pleura being injured at all. In the

empyema from pleuritis, the lungs will become compressed, and produce symptoms indicative of the presence of matter, which can be discovered without difficulty; whereas in the case when the matter collects in the cellular tissue, beneath the bone and external to the pleura, no such symptoms will be present; nor will the lungs be compressed, without the collection of matter be very great, and then it becomes evident by appearing between the ribs; and the patient can soon be relieved by making an opening in this situation.

When the one portion is driven beneath the other, and the fracture is simple, it will not be necessary to cut down upon the bone merely on account of the depression; and the fact of making the fracture compound, and having to pass the elevator between a spongy bone like the sternum, will be likely to do more mischief, by giving rise to inflammation, than leaving the portions of bone in their depressed state; for without there be evident symptoms, such as oppression to the breathing and great pain, it will be better to let it remain. The depression however is seldom very great, without the force has been very violent, and then the injury done to the viscera is generally sufficient to destroy the patient; so that the fracture becomes comparatively of little consequence.

The plan of treatment to be adopted in fracture of the sternum, is to prevent as much as possible, motion taking place between the two portions of bone, for if this be not done, the friction of the fractured surfaces against one another, will cause irritation and inflammation in the neighbouring textures, causing the pleura to become affected, or else abscess to form between it and the bone. The portions of bone are to be fixed by confining the whole thorax, so that the

patient can breathe by the diaphragm only. This is done by swathing the chest tightly with a broad flannel or cotton roller, and before applying it the patient should be told to make a deep expiration, so as to depress the ribs to the utmost, and to prevent motion more decidedly than would be done if the bandage were put on with the chest partially expanded; for then there would be room left for some contraction still, which the patient would take advantage of, and so move the portions of bone and loosen the bandage. The first turn of the bandage should be made on the lower part of the chest, and then carried upwards, for by so doing less pressure will be required on the sternum itself, as the upper half of the thorax cannot expand to any great extent if the lower half be well fixed. If there be much disposition for the two portions of bone to move upon one another, a broad lath splint, well padded, may be placed along the bone, so as to make the pressure equal on both sides of the fracture, and to keep the ends of the bone on the same level. The patient should be raised in bed, and the feet supported to prevent him slipping down: this position gives great relief, and allows him to breathe much freer than when placed horizontally on his back.

The general treatment is to be conducted on the strictest antiphlogistic plan: general blood-letting must be employed at the time of the accident (without there be any decided reason against it, such as the patient being in a state of collapse from the shock produced by the injury, or naturally of a weak constitution), and should be repeated afterwards as often as the symptoms require it and the strength of the patient will bear it; the cough is to be allayed by opiates and expectorant medicines. Opium will be found of the greatest use

in old asthmatical people, in whom it is almost impossible to keep the portions of bone at rest, owing to the constant cough, which is always increased after an accident of this kind. An additional reason for trying to allay the cough is, that in patients affected with asthma the bandage cannot be so tightly applied, and consequently the portions of the fractured sternum cannot be so firmly fixed as they can be in other cases, so that the cough takes more effect upon them and destroys their apposition. It will be found that a large dose of opium, repeated at intervals, gives the patient great relief, and prevents a great many distressing symptoms. In people not so affected with asthma, great attention must be paid to the bandage, seeing that it is kept tightly applied, for upon this depends the comfort of the patient and his speedy recovery. There is generally a disposition for the bandage to slip down ; this must be prevented by attaching two cross straps over the shoulders, and then pinning them before and behind. The bandage should not be discontinued before the end of the fifth or sixth week, or a longer period, if any pain or difficulty of breathing remains ; for the inflammation is very liable to return in these cases, if the ends of the bone be allowed to move before they are perfectly united. The pain in many cases remains some time after the bandage has been discontinued, owing no doubt to the adhesions that have formed, not allowing the chest its free power of expansion that it possessed before the injury.

FRACTURE OF THE RIBS.

The length and curved shape of the ribs, and their articulation with the sternum by means of elastic cartilage, gives them a power of resisting a force when

applied to them, that otherwise would be continually causing their fracture. The close relation also of the ribs with one another, gives them additional strength, by causing the force to tell on two or more bones at the same time, so that the shock produced is divided amongst many ribs, instead of one. This is exemplified in the manner in which the ribs are fractured; for it is generally found that when one only is broken, that the force has been very smartly applied, and by some hard projecting substance, such as the corner of a table or the edge of a stair, so as to include only one bone at a time; whereas, when many ribs are included in the injury, the force has been of a very violent kind, such as falls from a great height, or by a wheel or a heavy weight coming upon the chest.

The elasticity of the ribs in young people gives them a great power of resisting fracture; while the absence of it in older people, and the cartilages as well becoming ossified, gives the bone little or no power of yielding to pressure, except by breaking altogether, and causes fracture of these bones to be a very common accident indeed in advanced life. The extent to which the ribs will yield in young people, without causing their fracture, has been exemplified in the case mentioned at page 239, when speaking of fractures of the sternum, where it was found that this bone was pressed back against the spine, so as to cause rupture of the trachea, without any fracture taking place in the ribs themselves.

The situation in which the fracture occurs, depends upon two causes, namely, the degree of elasticity the ribs possess, and the point of the bone to which the force is applied. In young people, in whom the ribs yield so much, the bone may break at a point remote

from the part struck, for it will bend first of all to a certain extent, and then fracture at the point where the flexibility ceases. For example, supposing pressure to be applied to the fore part of the chest, in a person in whom this elasticity of the ribs was present, the bone would very likely break at or near to its angle; while in another person, in whom this elasticity was absent, owing to old age or other causes, the bone would break at its centre, or at some point anterior to it, although the force might be applied at the same spot. The point at which the force is applied, causes a difference in the situation of the fracture according to whether it be on the anterior or lateral part of the chest; for, as already stated, when it is applied anteriorly, it will cause the bone to break far back; but when it is applied either to the side or the posterior part of the bone, it will generally cause it to yield at the point struck. This is a very important point to attend to, for upon it depends the probability or not of injury being done to the viscera contained within the chest; for when the fracture is produced by a force applied to the anterior part of the chest, the ends of the bone will be pressed outwards or from the pleura and lungs, owing to the rib being first of all rendered more convex or hooped before it breaks, which brings the force in a direction, that drives the fractured ends outwards, instead of inwards. Just the contrary happens when the force is applied to the side or posterior part of the rib, for then the pressure tells directly inwards, and tends to destroy the curve of the rib; so that the bone, when it breaks, becomes displaced inwards, and the fractured ends take the same direction. The great difference then between

the two cases is, that in the one the ends of the bone are driven from the pleura, while in the other they are driven directly against it.

The number of ribs broken, depends upon the extent of surface occupied by the force applied, for when a heavy weight comes against the anterior part of the chest, such as a wheel passing over it, as many ribs may be broken as the force comes in contact with. A fall from a great height upon the chest may cause many of the ribs to yield; I once saw a case of this kind, where nine or ten ribs on each side were fractured. It is, however, found that some of the ribs are more frequently fractured than others, depending on their situation and mode of articulation, rendering some more exposed, and more easily acted upon by a force when applied to them.

The first rib is seldom broken; for it is so short and thick, and so well protected by the clavicle and muscles of the chest, as to be little exposed to injury; and to be very capable of resisting a force, without it be very powerful indeed. It is accordingly found that it is seldom fractured without the clavicle, and never without great violence being applied, and great injury being done to the parts both internal and external to the chest. The two last, or floating ribs, are not often broken; for they are so small, and their articulation so slight, that they scarcely offer resistance sufficient for a force to act upon them. The ribs most frequently fractured, are the four lowest true, and the three upper false; for they are the longest, and the most exposed to injury. When the two last ribs are the seat of fracture, it may become an injury of a very serious nature; for the force required to break them, will be liable at

the same time to do mischief to the viscera within the abdomen;—either bruising the kidney, or the liver, if the injury be on the right side.

In addition to the causes already mentioned, as producing fracture of the ribs, it sometimes happens that the action of the muscles breaks them, during violent fits of coughing, or exerting any force with the muscles that take hold of these bones, that acts too powerfully or suddenly. There are two interesting cases published by Mr. Nankivell in the 16th vol. of the Medical Gazette, in both of which the ribs were broken during a violent fit of coughing; in the one, the fifth and sixth ribs snapped across, in the other, the tenth; the patients were both females, and their ages 63 and 59. Mr. N. is inclined to think, that fracture of the ribs from this cause, may take place oftener than is supposed, and that the symptoms are sometimes put down for those of inflammation of the pleura. I think it not at all improbable that such may be the case, for when we consider the different state of the bones in advanced age to that of youth, and more particularly in the ribs, when the cartilages become ossified, and so give a more fixed point for a force to tell upon them, it is easy to understand how a sudden and very violent action of the diaphragm or abdominal muscles, such as that produced by coughing, should be able to snap so long and thin a bone across.

The ribs are most frequently broken in one place only, but it sometimes happens that they give way in a second, in these cases the force is generally very violent, and the injury is frequently complicated with wound of the pleura or lungs. The junction of the cartilage with the rib is sometimes broken through,

or the substance of the cartilage itself may be separated; this kind of accident, however, is much rarer than the fracture of the bone.

The symptoms of fracture of the ribs are—pain, motion of the fractured portions, and the crepitus. The sharp catching pain in the side, opposite the seat of the injury, is often so severe as to prevent the patient drawing his breath, and causes great distress. The pain is increased on making the least attempt to inspire, or on making use of any motion of the arm or muscles attached to the ribs, that causes the bone to move from its place. This pain must not be taken by itself as a decisive symptom of fracture; for it often happens that a simple bruise on the side, when the serratus magnus or the upper portion of the descendens abdominis are injured, will produce symptoms very much resembling the catching pain of a fractured rib. The way to distinguish between the two cases is, to tell the patient to inspire, and then to make him raise the arm or stoop the body forward. If it be fracture, the pain will be felt on making the inspiration; if it be bruise of the muscle, it will not be felt till afterwards, when the muscles are put into action. This will serve as a general rule, though I have met with cases where no fracture could be discovered, and still the least attempt at inspiration caused a sharp pain in the side, opposite the part struck: and, on the other hand, I have seen cases where the existence of fracture was quite evident, and still the patients have suffered comparatively little. Another distinction between the fracture and the simple bruise of the side, is, that very often pressure on a part of the rib remote from the point struck, will produce pain when fracture exists,

owing to the motion rubbing the ends of the bone against the pleura; whereas, in a bruise, it requires the pressure to be made directly on the part itself.

When the fracture is situated very far back, it is sometimes difficult to produce the crepitus. The only way in these cases, is to press forcibly against the anterior part of the rib, or upon the sternum; when often the length of the bone allows of the ends being moved upon one another sufficiently to indicate that the bone is broken. When the fracture is in the middle of the bone, pressure directly applied opposite the seat of fracture, is sufficient, in the majority of cases, to cause the ends of the bone to grate upon one another. The hand may be laid flat upon the patient's side, and pressure made forcibly against the bone; or the two hands may be placed, one on either side of the fracture, and then pressed alternately inwards. When simple pressure will not produce the crepitus, it can often be got by placing the hand flat on the side, and telling the patient to cough; when the sudden action of the muscles will be sufficient to move the fractured ends, though the other kind of force could not.

The displacement that takes place between the fractured portions is, in the majority of cases, very slight, and more particularly if only one rib be fractured; for then no riding can take place on account of the two adjoining ribs serving as splints. Motion of the fractured portions is a decisive symptom when it can be got. It is not, however, often well marked; for, although there may be sufficient to produce the crepitus, there may not be enough to give the sensation of the two moving upon one another. The ribs naturally yield to a small extent when pressed upon; care must therefore be taken not to suppose this motion

to be dependant on fracture, when really none exists. The part of the rib in which the fracture is situated, can generally be ascertained by the crepitus and the seat of the pain: and these are the two most decisive symptoms of the nature of the injury, more particularly when the accident has been one likely to produce fracture. If the lung be wounded, there may be spitting of blood, and the escape of air into the surrounding cellular tissue, constituting emphysema.

The evil consequences arising from fracture of the rib are many,—some being more serious than others: one of the most common is, inflammation of the pleura; for this membrane is very liable to become inflamed, either from the irritation of the fractured ends rubbing against it, or from a direct wound caused by a spicula of bone passing through it. The lungs themselves are not unfrequently wounded, and may become inflamed also: but the more frequent consequence of their wound is the escape of air into the cavity of the chest, or into the cellular tissue external to it.

The inflammation of the pleura that comes on is, in the majority of cases, very circumscribed; for it remains round the seat of the fracture, and does not shew any disposition to spread, if the patient be treated actively. There are cases however (and these are generally when three or four of the ribs are broken, and by the direct force) in which the inflammation runs on to such an extent, that matter forms between the two pleuræ, and occupies more or less of the cavity of the chest, according to the quantity of fluid effused. When this is the case, the lung becomes collapsed, and often so completely, as to prevent any air passing into it, owing to the pressure of the fluid upon its surface. The treatment to be adopted in these cases,

is to open the chest, by making a puncture in the intercostal space, to let out the matter; and to attend to it as a case of empyema from idiopathic pleuritis.

When the pleura covering the surface of the lungs, is pricked or torn by the end of the rib being driven against it, the structure of the lung itself becomes implicated in the injury ; the immediate consequence of which is, that the air escapes from the opening made. The quantity that escapes is sometimes very trifling, and does not become a symptom of any importance: for when the wound in the lung is small, and confined to its surface, it may soon heal, and then all further escape is prevented. If, however, the wound in the lung be large, and extend deep into the substance of it, the air will get out freely, and produce a train of symptoms of the following nature:—Air escapes through the opening in the lung, and makes its way, either directly through the pleura costalis into the cellular tissue external to the chest; or else, it first of all escapes into the cavity of the pleura, and makes its way through the pleura costalis afterwards. The evidence of the air having escaped out of the chest, is the peculiar *crackling* which is felt when the skin is pressed upon, owing to the air being driven into different parts of the cellular membrane. The sensation produced under the fingers is so peculiar, that it cannot be mistaken after being once felt; and it immediately becomes a diagnostic symptom of the lung being wounded in some part; and in the generality of cases will be indicative of fracture of the rib, if the accident have been one likely to produce it, although the crepitus of the ends of the bone cannot be obtained. The emphysema is at first confined to the side of the chest, and is situated near to the fracture; but gradu-

ally, as the patient goes on inspiring, fresh portions of air escape, until it occupies an immense extent of surface, sometimes spreading over the whole body, even down to the toes and fingers.

While this external emphysema is going on, gradually occupying the cellular tissue of the whole body, it often happens that symptoms arise of the air escaping into the chest; for although the patient at first might not have any difficulty of breathing, owing to the free exit the air may have found by the fractured rib, this will not continue, but it begins to collect within the chest, and compresses the lung. A large quantity of air may escape before any very urgent symptoms come on, for the other lung serves to carry on the respiration for some time, together with the imperfect action of the injured one. By degrees, however, the wounded lung becomes so much compressed, that it ceases to act; the opening in it, however, still remains, and a fresh portion of air will escape from it, so long as the walls of the chest have the power of yielding; the consequence of which is, that each time the patient inspires, a fresh portion of air is drawn in and then presses against the diaphragm and mediastinum: the breathing now becomes more oppressed, for the sound lung begins to be impeded in its action, and the heart as well, and particularly if the injury be on the left side. It is now that the extreme difficulty of breathing commences, for the sound lung cannot expand to the utmost, and the wounded one is of no use; the symptoms then become extremely painful, the embarrassment to the breathing increases, at the same time that the circulation becomes disordered, by the altered position of the heart, as well as by the obstruction caused to the flow of the

blood through the lungs. If the patient be not now speedily relieved, the breathing becomes more oppressed, and the blood is scarcely changed in the lung, which is made evident by the lividity of the lips and surface of the body generally; the sufferings now become insupportable, the patient being unable to remain in one position for any length of time, and makes every possible effort to gain breath, by exerting all the muscles of respiration to the utmost. The circulation becomes more feeble, and the efforts to breathe gradually get less, jactitation of the arms and body generally takes place, the intervals getting longer and longer, until they cease altogether, and the patient dies in fact from suffocation.

Sir Charles Bell gives another probable cause for this difficulty of breathing that exists, even when the injured lung is not compressed so as to prevent it expanding, namely, the want of consonant action in the respiratory muscles, owing to the two lungs not playing together; he says, "There is a sympathy which pervades all the muscles of respiration, and even if the cavity of one side be distended, the muscles of that side cannot act, and their impeded action prevents the free motion of those of the other side."*

The treatment of the emphysema is different, according to the situation the air occupies, and the quantity of it extravasated. In those cases where it merely occupies a small extent of surface beneath the skin, and there is reason to believe that none has escaped within the chest, a bandage may be applied round the ribs, only moderately tightened at first, to see whether the confinement increases the difficulty of breathing; and if it does not, it may be tightened so as to fix the ribs

* Operative Surgery, vol. II.

completely, and keep the fractured ends at rest. Should the difficulty of breathing be increased by it, it ought to be loosened, as the air had much better escape externally than be confined within the chest.

If the distension of the cellular tissue be very great, punctures may be made in the skin to let the air out; and if there be also reason to suppose that the lung is prevented expanding to the utmost, from the escape of air within the chest, an incision may be made in the intercostal space, and it should be made as high up as possible, as then there will be more chance of the air escaping, though perhaps this is not very important, for it will escape from any opening that may be present when the lung begins to expand. I do not think it best to make it opposite the fracture, for then there will be the danger of the union of the bone not taking place so readily, on account of the fracture being rendered compound. This opening is only to be advised when the breathing is very much oppressed: a small quantity of air will not produce any serious consequences, and will soon be absorbed. The intercostal artery and vein are to be avoided, by making the incision as near to the upper margin of the rib as possible, since these vessels are placed along the lower edge of the bone. If the object in opening the chest, be to relieve the lung from the pressure of fluid, as in empyema or hydro-thorax, the incision should be made in the lowest intercostal space that circumstances will admit of, for the fluid will then drain more easily out, and the lung will be sooner relieved.

Erroneous opinions are sometimes formed as to the manner in which the opening made in the chest acts upon the future expansion of the lung. Many suppose that as soon as the air is let out, the lung becomes

expanded and fills up the space, but this is not the case, for if the wound in the lung be not healed, a fresh portion of air will of course escape, and so prevent the expansion as much as before. The object of making the opening in these cases, where it is necessary to do so shortly after the injury, is to relieve the lung from the immediate pressure upon it, and to prevent it becoming further collapsed; at the same time that the other lung is relieved, and the wound of the injured one rendered more likely to heal, by bringing it into a state of quietude. When the opening is made in the chest for the evacuation of matter or serum, the lung will not expand for some time afterwards, for it has now been longer in a state of collapse, and is very likely to have become adherent in parts from the inflammatory action that has been going on. The sooner the lung is relieved in these cases of effusion of fluid, the better chance it will have of recovering itself; for it often happens that the compression has been so great, and the adhesions formed have become so strong, that a very great length of time elapses before the air can make its way into the cells again; and from some cases that I have seen examined, the probabilities are that the lung may be brought into such a state, as never to be able to recover sufficiently to admit of expansion again; the cases I refer to, however, have been the result of severe attacks of idiopathic pleuritis, and not of the traumatic, which I am now considering; though no doubt the same effects would be produced, where the inflammation has been severe, and the operation not performed at an early period.

It sometimes, though rarely, happens that the intercostal artery is wounded by the edge of the fractured

rib; when this is the case, the blood will be poured into the cavity of the chest, and produce symptoms of pressure upon the lung. The treatment to be then adopted, when the symptoms are very urgent, is to make an incision at the lower margin of the rib opposite to the fracture, large enough to admit of the artery being taken up (a very difficult operation however), or to allow of a compress being applied, so as to lie in contact with the wound of the artery.*

When the fracture is at the posterior part of the rib, and has been caused by a very violent force, the ends of the bone may be driven against the substance of the heart; these cases are of course always fatal. The following is an instance of this kind.

Case.—A. B., æt. 21, September 16, 1835, was riding on the shaft of a waggon, when he lost his balance, and fell off, and the wheel passed over his chest. He was brought to the Middlesex Hospital, and died almost immediately after his admission. On examining the body after death, it was found that eight ribs of the left side were fractured, at their posterior part, about an inch from their tubercles; and the four middle ones were broken at the anterior part as well, causing a double fracture. The pericardium was filled with blood, and a large quantity had escaped into the chest as well. The left auricle was found to be torn, by the fractured ends of the ribs having been thrust against it.

* I think an instrument might be contrived to press against the intercostal artery, by having two plates; a small one to fit into the wound and to press upon the vessel, and connected with a larger one by means of a screw or spring, made to press upon the outside of the rib, so as to squeeze the vessel between the two forces that might be applied in this manner.

Sometimes the fracture does not unite, and the bone may become carious, causing irritation to the pleura and inflammation; or a fistulous opening may remain, leading down to the bone, owing to an abscess having formed externally, and without doing any mischief to the interior of the chest.

When the fracture is simple, and unaccompanied with emphysema, the treatment to be adopted is, to prevent the ends of the bone moving as much as possible, by swathing the chest tightly with a flannel or cotton bandage, and making the patient breathe by the diaphragm and abdominal muscles alone. The bandages should be applied in the same manner as recommended for fractures of the sternum, for the object is the same in the two cases. It should be commenced at the lower part of the chest, and carried upwards; making the patient expire as much as possible first. In some cases, where there are a great many ribs broken, the force has had a tendency to drive the fractured ends inwards: under these circumstances, a broad lath splint, or a piece of pasteboard, may be employed with advantage, by placing it over the fracture, and making it rest on the adjoining sound ribs; by so doing, the pressure of the bandage will be taken off, and the ends of the bone more steadied. I believe the splint applied in this manner might be employed with advantage in all cases where there are many ribs broken, by making the pressure of the bandage more equable.

As the perfect apposition of the ends of the bone, and the relief to the patient's sufferings, depend upon the ribs being kept at rest, the greatest care should be taken that the bandage be kept tightly applied; for

the slightest loosening of it will allow of motion of the thorax, and so disturb the fractured ends.

In the majority of cases of fracture of the ribs, the general treatment must be very active, and particularly during the first part of it. General blood-letting must be employed, if the patient's strength will bear it: for the object is to bring the system very low, in order to guard against the inflammation that is always to be looked for after this kind of injury. The bleeding must be repeated, if the pain in the side be sufficient to warrant it; and if it be not relieved in this manner, cupping or leeches must be employed, and blood be taken away locally as well as generally. Another reason for taking away blood in these cases is, to diminish the flow of blood through the lungs, and more particularly when the lung itself has been wounded. "Bleeding in this case not only prevents the membrane of the chest from inflaming, but, by diminishing the quantity of circulating blood, it relieves the respiration, because the extent and frequency of the distention of the lungs is proportioned to the quantity and velocity of the circulating blood." *

There are many cases, however, where general blood-letting cannot be practised, as when the patient is old, and of a feeble constitution; it cannot then be borne, nor is it required; for by paying strict attention to the bandaging and diet of the patient, the recovery will take place without any inflammatory symptom arising. But, of course, in these cases the inflammation may sometimes run so high as to render it necessary to take away blood; and then it had better be done locally, by cupping and applying leeches. Purgatives, I think, should not be employed to any great

* Sir C. Bell's Operative Surgery, vol. II.

extent in fracture of the ribs, more particularly where it includes many of them; for they only disturb the patient, by requiring him to move his position frequently, at the same time that the ends of the bone are necessarily pulled upon by the muscles that are then brought into action. The patient should be raised in bed during the first ten days or fortnight, for this position gives him more ease than lying horizontally. Opiates are often of immense advantage in fractures of the ribs, like those of the sternum, and more particularly in old asthmatical people; for they relieve the cough, and tend greatly to the comfort of the patient, and to facilitate the union of the bone.

The ribs generally unite at the end of three weeks, sufficiently to prevent motion of the fractured portions upon one another: the bandage however must be worn for a much longer period. It sometimes happens that a sharp catching pain remains for weeks after the bones are united, and is liable to return at intervals when the patient takes cold. In these cases, no doubt, there is some slight adhesion between the two pleuræ, which causes the pain that is experienced. In one case I saw, the pain had remained a long time after the fracture, when the bone was quite firmly united. Blisters may be employed with advantage in these cases; or cupping, which may be repeated at intervals.

FRACTURES OF THE PELVIS.

The bones of the pelvis consist of the two ossa innominata, the sacrum, and os coccygis. The os innominatum of either side is again subdivided into three bones, namely, the ilium, pubes, and ischium. Each of these bones may be fractured separately, and will produce different symptoms, according to the one the injury happens to be in. The os ilii is the broad expanded part, forming the larger portion of the pelvis, its structure is spongy, and less brittle than either the pubes or ischium, and the surfaces of it are thickly covered with muscle, so that the spiculæ of bone are not so likely to do harm to the viscera when this part is broken, as they are in fractures of the other two portions, for the pubes and ischium break with a sharper fracture, and are not protected in the same manner. The ilium is also more frequently fractured, for it is more exposed and its shape allows a force to tell more easily upon it; the bone of one side is generally fractured alone, but they may both yield when the force is very violent. When the pubes is fractured, the two bones are oftener included in the injury, for their position and more brittle structure, enables the same force to extend to both of them. The ischium is seldom fractured at its thick tuberosity, the ramus of the bone being the part that generally yields.

The causes of fracture of the pelvis are, as might be expected, always of a very violent kind; such as

falls from a great height, or some heavy weight coming upon the bones, as a wheel passing over them. The ilium may be broken by a kick from a horse, and I once saw a case where the pubes was fractured in this manner. The bones of the pubes, however, are most frequently fractured by a crushing kind of force, or by one that acts against the whole pelvis.

The situation of the fracture depends upon the kind of force applied; the ilium being often fractured by a fall from a great height, will bring the broad surface of the bone in contact with the substance on which the person falls, and will very likely cause it to break near to the acetabulum. When, however, the fracture is caused by a smarter kind of force, such as a kick from a horse, a smaller portion of the bone may separate, and the situation of it will be near to the crest of the bone. A wheel passing over the pelvis is a very likely kind of force to separate the bone near to the joint, of which the following case is an example; it also illustrates the manner in which the viscera may sometimes escape injury.

Case.—A. B., æt. 15, 1832, was brought to the Middlesex Hospital, said to have been run over by the wheel of a cart, the wheel having passed transversely across the pelvis. When the boy was admitted there was ecchymosis over the right inguinal region, and a distinct motion in the bone of the ilium of this side, which could be produced by taking hold of the crest, and then pressing it inwards and outwards. Two or three days after his admission, a large slough formed in the right groin, and separated, leaving a large granulating surface. Symptoms of inflammation of the peritoneum shewed themselves at first, but they

were soon subdued by the application of leeches, &c. No injury appeared to have been done to the viscera; and the bone united in about a month, the motion of the fractured portion getting less each day.

There are two reasons why the viscera are less liable to be injured in fractures of the ilium than in fractures of the ischium or pubes: the one is, as already stated, the covering the bone receives from the muscle that lines its inner surface; the other is, owing to the viscera themselves, that occupy the upper part of the pelvis, being moveable, and not easily acted upon by a force without it be very suddenly applied, or of a very violent nature. The direction the fracture takes may be transverse or oblique: it is more oblique when through the broad part of the bone, than when near to the acetabulum. It is sometimes situated so far back, as to give the idea that the sacro-iliac joint is separated. A case of this kind was in the Middlesex Hospital in 1834.

When the fracture takes place through the pubes or ischium, it may extend in many directions, and through many parts of the bone, owing to its structure being more brittle, and more liable to split when a violent force is applied.

The diagnostic symptoms that are present in fractures elsewhere, are not very evident, in many cases, where the injury is in the pubes or ischium, namely, the motion and crepitus; for it is difficult to get the portions of bone to move sufficiently, to make them grate upon one another, without the fracture has been very extensive, so as to split the bone in many directions. Motion can sometimes be obtained by moving the lower extremities in various directions, so as to

put the muscles upon the stretch that are attached to the pubes and ischium, and to make them pull upon the fractured portions of bone.

The evil consequences to be dreaded in fracture of these bones are—injury to the large blood-vessels, or to the bladder or urethra; for the spiculæ of bone may be so sharp that the above parts will be easily injured, if they are driven with any force against them. When the vessels are wounded, there is generally great ecchymosis; and I believe it is seldom from one of the large trunks, but that the blood is poured out by the smaller vessels that are torn through, and more particularly the veins. The extravasation often occupies an immense extent of surface, spreading up the abdomen and down the thighs and hips. When the bladder or urethra are wounded, and it is more frequently the latter part that suffers, there will be extravasation of urine as well as blood, and the blood in these cases occupies the perineum and scrotum and the inside of the thighs, and often extends up to the pubes as well. If the bladder be wounded, the urine escapes into the cellular tissue of the pelvis and parts around, passing down into the perineum and round to the groin. The presence of the extravasation is known by the peculiar crackling sensation that is given to the fingers when pressure is made upon the part, very much resembling that of emphysema, but perhaps it is of a more spongy nature. When the urethra alone is wounded by the ends of the bone being driven against it, the urine does not escape until the first attempt of the patient to make water, without the laceration extend very far back towards the bladder. It should be the object of the surgeon then, if he see the patient early enough, to prevent him making urine through the urethra without

the catheter; and if there be inability to hold the water, the catheter should be left in. The passage of the catheter will also indicate whether the bladder be wounded or not; for if the urine be clear and free from blood, the chances are that it is not; but if blood be present, either it or the urethra immediately beyond, will have suffered. It is not always easy to effect the introduction of the catheter, for the urethra may be so much torn, that the same difficulty will exist in passing it now, that is met with in cases where a false passage exits from other causes. In these cases great caution is necessary, and a thorough knowledge of the anatomy of the parts is requisite, to avoid doing mischief, by passing the instrument in a wrong direction; and it is sometimes found that the laceration is so great, that all attempts to introduce it are useless, and then nothing can be gained by making repeated trials to do so, but harm may be done by tearing the passage still more. The best practice in these cases is to make an incision down to the urethra, through the perineum, and to allow the urine to escape through the new opening made, or to introduce an elastic catheter through the wound into the bladder, if the state of the parts render this practicable. In fact the case is to be treated like extravasation from the urethra bursting, from stricture or other causes. When the cellular tissue in the perineum or scrotum is found to be filled with the urine that has escaped, or from the blood effused, free incisions must be made through the skin in various parts, to save it from sloughing, which it will be sure to do if the extravasated fluid be allowed to remain.

Fractures of the bones of the pelvis often extend through the acetabulum, more particularly where the force has been applied to the side of the bone, and

made to tell against the head of the femur. It sometimes happens that the thigh bone is driven through the acetabulum, causing it to be lodged within the pelvis. Sir A. Cooper mentions a case where the posterior margin was fractured, and the head of the bone rested on the dorsum of the ilium, giving the injury every appearance of dislocation. I lately saw a case of this kind myself, at the Middlesex Hospital, where a man was struck by a large piece of timber, which fell obliquely against the great trochanter: the position of the limb was that of dislocation on to the dorsum of the ilium. The man died of injury to the spinal marrow, and of fracture of the sacrum, which was produced at the same time. On examining the body after death, the posterior margin of the acetabulum was found to be broken off in two pieces, and to be displaced backwards. The only symptom in this case that did not correspond with ordinary dislocation was, the free motion that existed at the joint; for the hip could be flexed and extended with facility, which depended no doubt on the head of the bone being lodged on the fractured edge of the acetabulum, instead of completely on the dorsum of the ilium.*

It is owing to the above consequences, that the fracture of the bones of the pubes or ischium so generally prove fatal, for the injury done to the viscera is such, that the irritation and inflammation produced, cause so much fever to follow, that the patient ultimately dies from its effects.

No reduction is necessary here as in other fractures, for the displacement that exists is little or none, and of such a nature that it cannot be remedied. The object

* The preparation is in the Museum of the Middlesex Hospital School.

to have in view is to keep the lower extremities as quiet as possible, in order to prevent the powerful muscles that are attached to the bone from pulling upon the fractured portions: a broad bandage, passed round the pelvis, may be employed to support the bones, when there is no injury of the integuments to preclude its application; otherwise the patient should be laid on a soft bed, so that the pelvis may sink into it, and gain support laterally from the pressure that will then tell upon the sides of it; or the part may be supported with firm pillows placed against the hips. If the ilium alone be fractured, the bandage should include this bone only; as, if it press upon the trochanters of the femur, it will have no effect upon the ilium, and no support will be gained by it; and if it pass higher up upon the abdomen, it will only tend to push the viscera downwards, and be of no use in fixing the pelvis itself.

When the fracture is very extensive, so as to pass in many directions, and to include the acetabulum, advantage will be gained by employing Earle's or Amesbury's beds; for the hip and knee joints can then be supported, and all the weight of the lower extremities will be taken off the pelvis, and one advantage will always be derived from their use, namely, by allowing the patient's bowels to act, without the necessity of moving him each time to place the bed-pan beneath him; for they have an apparatus contrived on purpose at the bottom of the mattress, that allows of this being done without disturbing the patient at all; and this indeed is a sufficient reason for employing them always, when they can be obtained, for it is of the utmost consequence to keep the pelvis at perfect rest after a severe injury of this kind. One precaution, however, should be taken when these bedsteads

are used, which is, not to raise the shoulders too high, for then the weight of the body presses downwards and pushes the spine upon the pelvis, and causes the bones to be strained upon, and tends to separate the fractured portions.

At the same time that the local treatment is attended to, by adopting the means already mentioned, the general treatment should be very active as well, by bleeding the patient largely if the viscera are supposed to be injured, and otherwise adopting the strictest antiphlogistic regimen; leeches should also be freely employed according to the extent of local inflammation present.

The length of time that it is necessary to confine the patient to his bed, will of course depend upon the extent of the fracture, and the consequences it may have produced; but it is always necessary to do so for a longer period in this, than in other fractures, owing both to the union of the bone being slower, as well as the greater stress that is made upon the pelvis, than upon other bones, for the weight of the body above, and the motion of the extremities below, have great power of moving the fractured portions, and will do so if the union be not strong. Another danger to be feared also, is the return of inflammation in the adjacent parts, if the patient move about too soon. From three to four months are generally required for the patient to regain his former strength, and often a much longer period when the inflammation has been very active.

FRACTURE OF THE OS COCCYGIS.

This bone is more liable to fracture in old than in young people, for then the bone is more firmly fixed

and ossified, and offers more resistance for a force to tell upon. Its fracture is generally produced by a fall upon the part, or by a blow directly applied, as from a kick, &c. The symptoms are, pain in the part, motion, and crepitus of the fractured portions. The pain is often of the most severe nature, and is increased on the slightest pressure, and when the bowels act, for the end of the bone is then moved both by the passage of the fæces downwards and by the action of the sphincter ani muscle. It often happens that for some days after the injury, violent tenesmus exists, causing the most distressing pain to the patient, there being a constant desire to empty the rectum without the power of doing so, attended with violent spasm of the sphincter muscle. The pain in the part is also increased when the patient attempts to walk, for the bone is then pulled upon by the glutæi muscles, and by the ligaments that are attached to it.

The fracture is ascertained by passing the finger up the rectum, and then pressing the bone backwards and forwards; the unnatural degree of motion will then be felt. But it is not often that the crepitus can be got, owing to the surfaces of the bone being so small, and the kind of motion that is given to the fractured portion not being one likely to rub them against one another. The age and sex of the patient, however, must be considered when the free motion of the bone is taken as a symptom: for it must be remembered that in the female, this bone naturally possesses more motion than in the male; and that in youth also there is a degree of motion that does not exist at a later period of life, owing to the ossification being then less complete.

The pain is often so very severe in this kind of in-

jury, that the surgeon should endeavour to satisfy himself with regard to its nature by one examination; for then a deal of suffering will be saved to the patient, by not having to move the parts a second time.

If the portion of bone be much displaced (and it must always be inwards), it is to be brought back into its position by pressing gradually upon it with the finger in the rectum. The general and local treatment are simple, but they require to be active. The part should have leeches applied to it frequently; and cupping on the sacrum should be employed if the pain extend higher up, with the frequent use of hot fomentations, and occasionally of the hip bath. Warm enemata passed up the rectum often give great relief, with some laudanum introduced into them, if the tenesmus be very violent; a flexible tube should be passed into the bowel to administer them, and of a very small size. Violent purgatives should be carefully avoided, and all medicines that tend to irritate the lower bowel. Mild laxative clysters should rather be employed, so as to keep the rectum free from fæces.

This kind of injury, though apparently but trifling, is often very serious in its consequences; for the patient sometimes is a long time in recovering, and not unfrequently has symptoms remaining, which he never altogether gets rid of.

FRACTURES OF THE FEMUR.

The thigh bone is often fractured: for its shape and situation are such as to often expose it to injury, and to allow a force to act easily upon it, when violently applied. The length of the bone increases a force when applied to it, by giving it a lever power, and enabling it to tell upon a part of the bone remote from the point struck. It is accordingly found that fractures of the thigh are as often, if not oftener, produced by the action of the indirect as by the direct force; and this circumstance renders the soft parts round the bone seldom liable to injury in the simple fracture, for the length of the bone allows the force to fracture it without extending afterwards to the surrounding muscles, so that simple fracture of the thigh may be said to be an injury that almost always terminates favorably; for though it would seem at first, that so large a bone could not be broken without producing serious mischief to the system generally, it is found that no simple fracture which the surgeon has to manage, gets well sooner, and less endangers the patient's life, if properly treated.

The thick covering of muscles which the thigh bone receives, renders it, comparatively speaking, little liable to compound fracture: for the kind of force that usually acts upon the femur, is not sufficient to drive the ends of the bone through the soft parts. The fracture however is sometimes compound; and it may be produced in two ways, namely, by the force telling di-

rectly on the limb where it breaks the bone, when the soft parts are crushed from without inwards, owing to the blow being applied externally; or the ends of the bone themselves may cause the compound fracture, by being thrust through the muscles and integuments, from within outwards, by the force telling upon them afterwards. It is of great importance to consider these two distinctions, for the extent of injury is much greater in the one case than in the other. In the latter case, where the ends of the bone are driven through the soft parts, the muscles, though injured to a great extent, are not so seriously hurt as when the direct force acts upon them; for then the degree of injury done need bear no relation to the extent of fracture in the bone, but may include the soft parts at some distance off, and destroy their vitality by crushing them rather than tearing them. The following case illustrates the action of the direct force in producing the compound fracture; and shews the great extent of injury that may be done to the soft parts, and yet the bone itself be only broken in one place.

Case.—William Squelch, æt. 16, admitted into the Middlesex Hospital, August 5, 1832; was brought from Hanwell, where the accident happened; stated that he was walking by the side of a waggon, when he was jammed between it and another one that was passing at the same time; and the two wheels caught his thigh and fixed him there, crushing the limb very violently. The injury done was most extensive;—there was found to be a large lacerated wound, extending from the groin down to the inside of the knee, below the head of the tibia; the sartorius muscle and portions of the adductors were torn through, and the femoral artery and vein also, neither of which had

bled to any great extent, but had stopped of themselves previous to the boy's admission; the thigh bone, with all this mischief to the soft parts around, was found to be only fractured in one place, and this just below its centre. The limb was amputated by Mr. Mayo;—the boy only survived the operation four days, the shock of the accident having been so great.

The causes which produce fractures of the thigh are very numerous. When the direct force acts, it generally happens that the limb is crushed by some heavy weight falling upon it. When the indirect acts, it is most frequently found that the person falls from some height, with the thigh in such a position that the bone snaps at some part remote from the point struck. Some parts of the bone break by the weight of the body telling directly upon them; as when the neck of the femur fractures by the person making a false step, fancying that he is upon level ground when he is not so; the whole weight of the body may then tell upon the neck of the bone, and cause it to break.

When the articulation of the femur with the acetabulum is considered, and the lever power given to the bone by its great length, it might at first be thought more liable to dislocation than to fracture; but this is not the case, for the strength of the ligaments, and the tendency of the muscles to keep the bone in its place, are such, that they are sufficient to resist the generality of forces, without they be applied in a very particular direction. The most important reason, however, why the fracture occurs so much oftener than the dislocation, is, that the length of the bone gives the force so much lever power, that it causes the bone itself to be comparatively much weaker, and to break before the strain can come upon the joint.

A bone of such great length as the femur, and shaped so differently at its two extremities, causes its fracture to vary very much, with regard to the situation in which it occurs; and as to the symptoms that may be produced, it therefore becomes important to thoroughly understand the anatomy of the bone, and the relative position of the muscles attached to it. The structure and shape of the bone vary very much; some parts being more brittle than others, and more under the influence of forces either applied externally, or produced by the weight of the body telling unequally upon it. The shaft of the bone is more brittle than either the neck or the condyles, owing to its structure being more compact, and not of a spongy nature as these parts are. This difference in the structure and shape of the various parts of the bone, will be found to influence the direction and the situation of the fracture; thus, the shaft being so long and of so brittle a structure, renders it the most liable to fracture; fracture of the neck of the bone occurs next in frequency, owing to its shape favoring the action of a force upon it; while the condyles are less frequently broken than any part, owing both to their shape and structure giving them strength and depriving them of brittleness. Fractures of this bone then may be considered under three heads,—First, those of the shaft of the bone. Secondly, those of the lower end of it (including the condyles). Thirdly, those of the upper end (including the neck of the bone and the great trochanter).

FRACTURES OF THE SHAFT OF THE FEMUR.

The most frequent cause of fracture of the shaft of the bone, is, by the person falling with the limb obliquely under him, so that the weight tells more upon

one part of the bone than another; or the thigh may be struck against some hard projecting substance, or it may receive a heavy weight upon it, so as to cause the bone to break directly at the part to which the force is applied. The fracture may extend in any direction, being either transverse or oblique, and in children it is more frequently the former: it may also be situated in one or many places, and may be comminuted, and simple or compound. The direction of the fracture is an important point to ascertain, for the reduction of the ends of the bone may be influenced by it. It is not, however always easy to do this, without the end of the bone be pushed forward so as to become more superficial than it naturally is when surrounded by its thick mass of muscle. The situation of the fracture may be in any part of its length, but it is most frequently found to be within the lower two-thirds.

The general symptoms of fracture of the thigh, are similar to those met with in other fractures. There is pain in the situation of the injury, being dull and aching rather than acute; inability to move the limb, or to bear any weight upon it; motion in a part of the bone, where naturally none ought to exist; a crepitus when the fractured surfaces are moved upon one another; and a deformity in the shape of the limb, corresponding with the degree of displacement of the ends of the bone, caused by the situation and direction of the fracture being such as to allow of the ends of the bone being moved from their apposition.

The particular symptoms to be looked for, are those which indicate the part of the bone in which the fracture exists; the direction the fracture has taken, and the position of the ends of the bone. These symptoms are made evident by the displacement of the one por-

tion upon the other, producing increased thickness in one part of the limb, at the same time that there is motion found in the situation corresponding with the deformity in the shape; the prominent end of the bone can generally be felt projecting on one side, while there is a corresponding depression on the other. All these symptoms vary in extent.

When the fracture extends transversely across the bone, the displacement may be very slight, and often none at all, for the fractured surfaces of the bone being flat and regular, allow of the two ends being locked together, and guards against their apposition being disturbed. It is not, however, uncommon to find displacement in some cases of the transverse fracture, and to a considerable extent, so as to produce great shortening of the limb. This happens where the force applied has been very violent, and has acted upon the ends of the bone after it has caused their fracture, so as to push them from their apposition; or the displacement may also be caused by carelessness in carrying the patient, by not supporting the limb on the same level. The apposition of the ends of the bone in the transverse fracture, may also be disturbed by the action of the flexor muscles of the hip, which may tilt the end of the upper portion of bone upwards, and then the other muscles may pull upon the lower portion, and draw it behind or to one side. In the fracture just below the trochanter minor, this action of the flexor muscles is one of the chief causes of the displacement, and the most troublesome one to guard against. In the majority of cases, however, I do not think that the muscles have much to do with the primary displacement, but that the force that produces the fracture, first of all

pushes the ends of the bone from their contact, and that the muscles then act secondarily only.

Although in the transverse fracture, there may not always be displacement with regard to the length of the limb, there generally is with regard to the long axis, for the lower portion may be rotated outwards, while the upper remains stationary. When the patient is placed in bed upon his back, this rotation of the lower portion outwards becomes very apparent, by the extreme eversion of the foot and knee; and in almost all fractures of the thigh, whether it be through the neck or shaft of the bone, this is found to be a very prominent symptom. The cause of this rotation outwards I do not think is fully accounted for. It is said that the muscles attached to the bone have a great deal to do with it: no doubt they have the power of producing it, but I do not believe that they often act in this manner, and there is quite a sufficient reason to explain it without having recourse to the muscles,—I mean the shape of the limb. The inner and outer edge of the leg and thigh differ greatly as to the line they form, and in the degree in which they support the limb posteriorly, when it is lying horizontally; for the inner side of the calf of the leg is much more fleshy, and extends more beyond the edge of the bone than the outer side; the consequence of which is that when any pressure is made upon its posterior surface, it pushes this mass of flesh still more in this direction, and so presents a decided obstacle to the rotation inwards: whereas the outside of the leg is smooth and round, and presents a firm surface which favors rotation in this direction, and more particularly since there is so great an obstacle to its being rotated in the oppo-

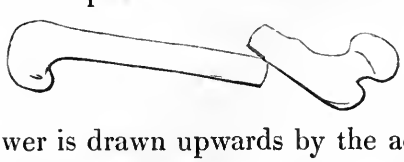
site. I conceive that the simple weight of the limb is sufficient to roll it outwards, when the shape of its outer surface is considered, and when the shaft of the bone is broken, and so having deprived the lower portion of its natural support. The upper portion cannot be rotated outwards, owing to the great trochanter, which will check motion in this direction when the patient is lying on his back; besides which, there is no disposition for the upper portion to roll in this direction, or inwards either, for there is not the weight of the leg and foot to drag upon it now that the bone is broken, which there is upon the lower portion.

When the fracture is oblique, the direction of it is indicated by the retraction that takes place of the lower portion of bone, and it is found extremely difficult to prevent this taking place; for no sooner is the extension discontinued, by which the limb has been brought to its natural length, than the muscles act, and draw the lower portion above the upper again. The reason of this is obvious, namely, the obliquity of the fractured surfaces, which prevents the ends of the bone being locked together; so that the muscles have nothing to oppose their action, or to prevent them producing the consequent displacement that takes place. The upper portion of bone is also sooner tilted up by the action of the flexor muscles, where the fracture is oblique, for there is nothing now to oppose their action. The degree in which this upper portion is tilted upwards, depends upon the situation of the fracture: for the nearer it is to the trochanter minor, the less resistance will be offered to the flexor muscles, and the easier they will act; whereas, when it is situated lower down, the weight of the leg presses against its lower end by means of the muscles that lie on it; and the length of the bone also increases the

effect of the weight, by giving it a lever power. The lower portion is drawn upwards by the extensor muscles of the knee, as well as by the adductor muscles, and by the magnus in particular; which latter muscle will also have a tendency to draw the lower portion of bone inwards.

At the same time that the limb becomes shortened, it also often becomes increased in width; for the abductors may act powerfully upon the upper portion of bone, and pull it outwards, causing a prominence to be felt in this situation; while the adductors may pull the lower portion inwards, and cause a prominence in this direction also, though it is not so distinctly felt, on account of this portion of bone lying deeper. The prominence of the upper portion of bone in fractures of the shaft of the femur, can generally be so distinctly felt, that its presence or absence can always be taken as a guide to the surgeon, with regard to the good or bad apposition of the fractured ends. Another kind of deformity that may exist in fractures of the thigh, is, that the lower portion of bone may lie at a different angle to the upper, without the fractured ends having completely lost their apposition.

The most common position, however, for the ends of the bone to be displaced in, is, for the upper portion to be tilted upwards by the action of the psoas magnus and iliacus internus muscles, and slightly outwards by the glutæi;—as represented in the wood-cut;—



while the lower is drawn upwards by the action of the extensor muscles on the anterior part, and of the hamstring muscles behind: it is sometimes also drawn inwards by the adductors.

That the above is the most frequent kind of displacement, is borne out by the various preparations that are preserved in the different museums; for, in nine out of ten of the specimens of fracture of the shaft of the bone, the above deformity will be found to exist in a greater or less degree.

The exact situation of the fracture is not always easy to discover; for if the thigh be very muscular or very fat, it is difficult to feel the ends of the bone sufficiently distinct to decide with accuracy. In a thin person, however, this point is easily ascertained. The deformity in the shape of the thigh is not so great in a fat person as in a thin one; for the outline of the limb does not become so much altered. The most certain indication as to the point in which the fracture exists, is gained by ascertaining at what part of the limb the unnatural flexion can be given to it, by moving the thigh in opposite directions; and this can often be done, although the ends of the bone themselves cannot be very distinctly felt, so as to decide upon the direction of the displacement. This however can only be obtained when the fracture is in the shaft of the bone; for when it is near either of its extremities, the difficulty of moving the fractured ends is greatly increased, and sufficient motion cannot be got to point out the situation of the injury.

The crepitus is a symptom, that, in this as well as in other kinds of fracture, cannot be produced, unless the ends of the bone are in contact; on which account it not unfrequently happens in simple fracture of the thigh, that no crepitus can be produced by rotating the lower portion upon the upper; for the ends of the bone are often so much displaced, that the fractured surfaces do not rub against one another. Under these

circumstances, extension has to be made upon the limb, until the lower portion is brought down opposite to the upper; and then rotation will cause the crepitus to be produced. The crepitus, however, is a symptom that is not often required in fractures of the shaft of the thigh bone; for the displacement and consequent deformity in the shape of the limb, and the unnatural motion in a part of it, where the continuity ought to be perfect, are generally sufficient to decide upon the nature of the injury. In very fat or large thighs, where the above symptoms are not so well marked, the crepitus may be of use in forming the diagnosis; for when once it is felt, it will be sufficient by itself to indicate that the bone is fractured.

TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR.

The numerous splints, and different kinds of apparatus, that have been invented for the treatment of fractures of the thigh, are sufficient to shew that it is an injury, which is sometimes very difficult to treat, and often requiring great force to be applied in order to reduce the ends of the bone to their proper place, and to keep them there. This difficulty is somewhat explained, when the large and very powerful muscles that are attached to the bone are considered, and the action they can exert upon the portions of bone where fracture exists: for it will be seen how soon the apposition of the ends of the bone can be destroyed, and how slight a force will be necessary to draw them from their line of contact. The necessity, however, for the employment of this extreme violence forms the exception, rather than the rule, for treating fractures of the thigh.

There are two plans of treatment gone upon in this kind of fracture; and though they are quite opposed to one another as to the principle on which they act, they both have equally strong advocates, and are both very generally employed: the one is called the treatment by extension—the other, the treatment by position. In the former kind, mechanical violence is employed to overcome the muscular action, and to keep the portions of bone in their place—in the latter, simple relaxation is made use of, by putting the limb into a position that takes all strain off the muscles. It is my intention to consider both these plans of treatment separately, and to point out those cases in which they are each of them applicable. For it will be found that they cannot both be employed with equal advantage in all cases. They are neither of them, however, to be condemned on this account: which many are inclined to do with regard to a particular kind of treatment, and because they meet with one case in which it does not answer the desired end, they condemn it altogether. I hope to be able to shew that both the treatment by extension, and the treatment by position, possess advantages in particular fractures; and that they both may be employed with success, by attending to the principle on which they act, and by adapting them to those cases only to which they are applicable. I shall first of all speak of the treatment by position. When any fracture is treated by position, it implies that no forcible means are employed to overcome the contraction of the muscles; but that the limb is placed in a position that tends to relax those muscles that are disposed to act powerfully, if put upon the stretch, and to cause displacement, and prevent the ends of the bone being brought

into apposition. By position, the ends of the bone are easily brought into contact, and are as easily kept there, owing to the muscles being relaxed. The treatment by position, is the plan that was so strongly advocated, and so extensively employed, by Pott. He conceived that it possessed decided advantages over the treatment by extension; for by it the relaxation of the muscles is obtained, and facility offered to bring the ends of the bone into apposition; which apposition is easily preserved without employing mechanical violence.

The importance of relaxing the muscles connected with the fractured bone, is often seen when there is difficulty in reducing the displaced portions. Extension may be exerted to a very powerful degree upon the limb, and for a long time, without producing any benefit, but in many cases only increasing the spasm; when it will be found that by simply altering the position of the limb, and by attending to the situation and direction of the fracture, and by relaxing the various muscles connected with the displaced portions of bone, all difficulty is immediately removed, and the ends of the bone are brought into contact. The importance of this relaxed state of the muscles, in preserving the contact of the ends of the bone, is also great; for sometimes if the limb be removed, only to a very slight extent, from that position which obtains this relaxation, spasm comes on and produces displacement. Pott recommended the treatment by position more particularly in those cases, where, from the severe nature of the accident, or from other circumstances, great bruising of the limb had been produced, or where there was much tumefaction present: and these cases are often met with when the patient has

been improperly carried, or when the limb has been carelessly supported : the ends of the bone may then do mischief to the soft parts around, and cause inflammation and swelling to come on. Under these circumstances, the state of the limb may be such, as totally to preclude the application of any mechanical means, such as the treatment by extension requires. The only treatment that can now be employed, is that of position, by placing the limb so that all tension may be removed from the muscles, already bruised and irritated, and requiring rest and relaxation more than any thing else. It must be allowed, even by those who are opposed to the treatment by position, that in these cases that of extension cannot be employed, for sufficient force cannot be applied to the limb to exert the degree of violence necessary to overcome the contraction of the muscles. The only rational treatment under these circumstances, is to relax all the muscles as much as possible, and to avoid all mechanical pressure.

However reasonable this treatment by position may appear, and however good the practical results obtained by its employment may have been, it is not without its opponents, for there are some who condemn it as decidedly bad. Desault was one of the first to start objections to it, and many others have done so since his time. The position which Pott recommended for fractures of the thigh, was to make the patient lie upon his side, and to place the limb upon its side also, and then to flex the knee and hip joints, by bringing the thigh up towards the pelvis sufficiently to relax the flexor muscles that act upon them. It does not require much consideration to see the different state the muscles must now be in, to when the patient is

made to lie upon his back with the hip and knee joints extended; for now all those muscles are put upon the stretch, that in the other position are completely relaxed. Desault makes the following objections to Pott's position;—he says, "But the difficulty of making extension and counter-extension, the limb being thus placed,—the necessity of applying them to the bone itself that is broken, and not in a situation remote from the fracture, at the lower part of the leg for example, —the impossibility of comparing, with precision, the injured thigh with that of the sound side, in order to judge of the regularity of the conformation,—the uneasiness which this position continued for a long time occasions, although at first it may appear natural,— the inconvenience and painful pressure of a part of the trunk upon the great trochanter of the injured side,—the derangement to which the limb is exposed when the patient goes to stool,—the difficulty of fixing the limb sufficiently to prevent the effect of his movements upon the femur,—the evident impossibility of this method when the two thighs are fractured,—lastly, experience so little favorable in France to this position. Such were the motives which determined Desault to have recourse to it no more, after having tried it on two patients, one of whom had a considerable shortening, in spite of the most scrupulous attention."*

I believe that some of these objections made by Desault, are worthy of consideration as far as they concern the inconvenience of Pott's method of putting his principle into practice; but the principle itself I do not consider at all subverted by them; and I hope to be able to shew that it is not, hereafter, when I come

* Desault, Œuvres Chirurgicales, par Xav. Bichat, tome I.

to speak of the use of the double-inclined plane for the treatment of fractures of the thigh. I shall first of all consider the advantages gained by Pott's position, and then point out those objections which appear to stand good against its employment.

By placing the limb on its side, and flexing the hip joint, those muscles which tend to draw up the upper portion of bone are relaxed (which muscles are, the psoas magnus and iliacus internus); and the lower portion of bone can be easily accommodated to this new position of the upper, by bringing the knee forwards and upwards into a line that corresponds with it. When the two portions of bone are so placed, they will remain in apposition, for all disposition to spasm is removed. Another point gained by this position is, that the lower portion of bone can now be moved into any line that may be necessary to ensure its proper contact with the upper.

The above are the points gained by the treatment by position, as employed by Pott, and the inconveniences attending it are the following. The position, making the patient lie upon his side, is certainly objectionable, when it is considered that it has to be continued for a great length of time; for it must naturally become irksome and fatiguing, and the pressure on the great trochanter must cause pain and irritation to the skin that covers it, and produce inflammation or sloughing, if care be not taken to place something beneath it to protect the parts. The necessity of this position being preserved, to ensure the proper apposition of the two portions of bone, causes the patient to become tired, and disposed to turn upon his back, which he will most probably do while he is asleep, if he take care not to do so while awake; the consequence of

which will be, that the upper portion of bone will be taken with the pelvis, while the lower one remains behind, being kept there by the weight of the knee and leg. The ends of the bone will then become displaced, and require a fresh reduction to bring them into apposition again.

The difficulty of ascertaining with precision the length of the two thighs is also a disadvantage;—for the only correct points to measure from, cannot now be got at in the fractured limb, namely, the great trochanter and the outer condyle. The measurement from the spinous process of the ilium to the patella, or inner condyle, is not sufficiently exact where the hip joint is bent, for it is difficult to say whether the pelvis is placed exactly on its side; and if it be not, the distance of the two spinous processes to the extremity of the thigh bone will not correspond. In thin people, who have small thighs, this difficulty is not so great; for in the generality of cases the bone can be traced throughout its whole length, and any irregularity felt that may be present, owing to the ends of the bone not being in direct apposition. But in fat people, or in large muscular thighs, the facility of feeling the bone does not exist: and then it becomes necessary to have some points to measure from, by which the length of the limb can be ascertained.

The possibility of the patient moving the pelvis, and with it the upper portion of bone, will always give reason to fear that its line of apposition with the lower will be disturbed, either by the patient turning to relieve himself from the irksome position of lying on his side, or moving involuntarily while he is asleep.

One of the objections made by Desault to Pott's position, is, that extension and counter-extension can-

not be employed: but this is of very little value; for Pott's object in recommending it was to do away with the necessity of making any extension, by relaxing all the muscles that tend to produce displacement; so that there might be no disposition for the portions of bone to ride upon one another. Another objection made, is, that it cannot be employed when both thighs are fractured; but this is so rare an accident, compared with the fracture of one thigh singly, that if the treatment answer well in all the cases of fracture of one thigh, the fact of its not being applicable when both are the seat of injury, is not a sufficient reason to condemn it altogether,—the single case then becomes the exception. These are the principal objections made to Pott's treatment; and no doubt they are important as far as they concern his method of putting it into practice, but I shall shew hereafter that they have no influence with regard to the principle itself on which his treatment was founded.

The treatment of fractures of the thigh by *extension*, is founded on a principle quite opposed to that of *position:* for the extension acts by means of force applied to the limb, so as to overcome the resistance of the muscles, and to bring the fractured ends into apposition by mechanical violence; while the former, as already stated, acts by producing complete relaxation. So strongly do some advocate this treatment by extension, that even in cases where from spiculæ of bone, or injury done to the nerves, or from other causes, there may happen to be more than usual spasm of the muscles to oppose the reduction of the fracture, they say, that there then is an additional reason for making more forcible extension. "In these cases Desault obtained the happiest result, by placing the limb in con-

tinued extension: the muscles, being fatigued by the state of preternatural extension that they are in, relax little by little, their force diminishes, they yield at last, and the reduction is effected."*

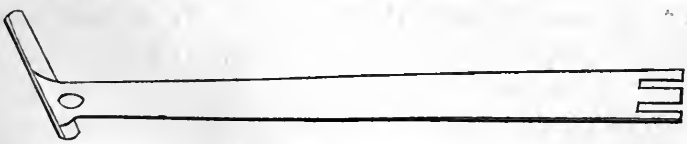
How this is opposed to the treatment by position, and to the treatment of fractures in general must be evident; and how, in the majority of cases, it must be injurious to the limb to make such forcible extension upon the muscles, while in this irritable state, and more particularly when there is much bruising or laceration of their fibres. But, allowing the force of extension to be capable of overcoming the powerful contraction of the muscles; and that by it the reduction of the bone can be effected, and all further displacement guarded against so long as it is kept up—how much better, and how much more convenient, must that method be, by which the same end can be obtained, without applying any force at all; and which preserves the ends of the bone in apposition, without the necessity of applying any mechanical violence. The treatment by extension is by some recommended in all cases of fractures of the thigh, in whatever situation it may happen to be;—many surgeons giving it a decided preference over that of position merely.

The force employed to gain extension, is made by means of a splint of some kind, which embraces the whole limb, and which is long enough to extend from three to four inches above the pelvis, so that two fixed points may be gained; the lower part of the splint being fastened to the foot on which the extension is made, while the upper is connected with a bandage; which when the leg has been extended to

* Œuvres Chirurgicales, tome I.

the utmost, is fastened to the pelvis, under the groin, and then becomes the counter-extension.

It is not my intention to describe the various kind of splints that have been invented and employed to keep up the continued extension; for they are so numerous, and the majority of them quite forgotten and out of use: I shall confine myself to the means employed in the present day, as being the most simple, and those from which most advantage can be derived. The apparatus generally employed to make the extension with, is the long splint, known by the name of Desault's splint. It is made of a long piece of wood, which extends from the foot up to some way above the crest of the ilium; its widest part, which is at the upper end, is about four inches; from which point it narrows gradually, and at the ankle is about two inches and a half. The lower end of the splint is by some only notched to allow of the bandage fixing into it: but I think more advantage will be gained by having a foot-board fastened to it, at a slight angle, to correspond with the natural bend of the ancle; for then the splint can be more firmly fixed, and without the necessity of making so much pressure laterally. The side of the splint opposite the outer ancle has a hole made in it, to admit the prominence of the lower end of the fibula. The wood-cut represents the kind of splint recommended, which is also notched at its upper extremity, to fix the bandage to that makes the counter-extension.



It is applied as follows:—The whole splint is first

of all to be padded with some soft substance, as tow, wadding or flannel, and made to fit the shape of the splint. Flannel perhaps makes the best cushion, for it can be made more neatly and fits more closely and evenly, both to the limb and splint; it is to be cut into pieces the shape of the splint, making it wide enough to extend some little way beyond the edge, to guard the skin from the pressure of it; four or five layers will be enough and they may then be sewn together. The advantage of the flannel over the tow or wadding is, that it is firmer and more elastic, and is not so liable to get into lumps. Having applied the pad to the splint, the patient is to be drawn to the edge of the bed, so that the limb may be got freely at. An assistant then takes charge of both legs, being seated before the patient, and rests the sole of the foot of the sound limb on one of his knees, while he grasps the foot of the other limb, and pulls it towards him. A second assistant takes charge of the fractured thigh, supporting the part opposite the injury. The whole limb is now to be rolled evenly from the toes up to the groin, so as to make equal pressure on the muscles and blood-vessels, and to protect the integuments from friction. The splint is next to be applied, seeing that the pad fits it well, and particularly opposite the ankle, for the prominence of this part of the limb is more pressed upon than the remainder of it. Care must be taken to see that the outer ankle fits into the hole made for it, and that the foot presses flat upon the foot board. When the splint is thus properly adapted to the limb, it is to be fixed to it by means of a bandage carried from the foot upwards; the foot and leg are to be the parts that are first of all to be secured, and more particularly

the foot, which is to have the bandage passed many times round it; when the bandage comes up to the knee it is to be given to an assistant to hold. The extension upon the limb is next to be made, by pulling the leg forcibly downwards, while the pelvis and trunk are fixed above. As soon as the extension is made to the utmost, the upper part of the splint is to be fixed by passing a bandage round under the groin, and making the two ends meet in one of the notches, and tying them there. This bandage then forms the counter-extension, and prevents the shortening of the limb taking place. The remainder of the bandage is then to be passed upwards, from the knee to the groin, to fix the thigh to the splint, and give it support generally; when the bandage has arrived at the groin, it is to be passed round to the opposite side of the pelvis, and back again round that part of the splint that presses against the great trochanter, and above the crest of the ilium, and this may be done for three or four turns so as to fix it firmly to the pelvis, and to prevent all motion in the portion of the thigh bone connected with the hip joint. One or two turns of the bandage may be passed from the groin, through the notches at the upper part of the splint, and then pulled downwards to the groin again, so as to prevent more effectually retraction upwards. A firm lath splint may also be placed along the anterior part of the thigh, extending from the groin down to the knee, to give more support to the central portion of bone, and to prevent the bandage pressing the fractured ends from their apposition.

The advantages of this kind of splint are, that the whole limb is firmly fixed, and the pelvis and lower

extremity are made as one bone, at the same time that the portions of bone are prevented being drawn past one another, if the extension be well kept up. The eversion of the foot can always be obviated, by keeping the splint firmly pressed against the outside of the knee and great trochanter, and by seeing that the sole of the foot rests flat upon the foot-board. The advantages of this position over that of placing the patient on his side are, that it gives him much more ease, and without the fear now of any motion of the pelvis producing displacement of the portions of bone, for the patient cannot turn, without taking the whole lower extremity with him, owing to the manner in which it is fixed to the pelvis; the bed-pan can also be placed beneath him, without danger of disturbing the limb for the same reason.

With regard to the cases in which these two kinds of treatment are applicable, I should say that the treatment by extension, should be employed in those fractures where the injury is situated above the lesser trochanter; and that the treatment by position, is better adapted for those where it is situated in the shaft of the bone. My reasons for making this distinction, I shall state when speaking of fractures of the upper end of the thigh bone.

In fractures of the shaft of the bone, that treatment will be found to be the best, which combines the principle of position chiefly with that of extension in a partial degree, for that position will relax the muscles and allow of the proper apposition of the ends of the bone being obtained, while the slight extension will prevent retraction taking place, either owing to the fracture being very oblique, or from some little dis-

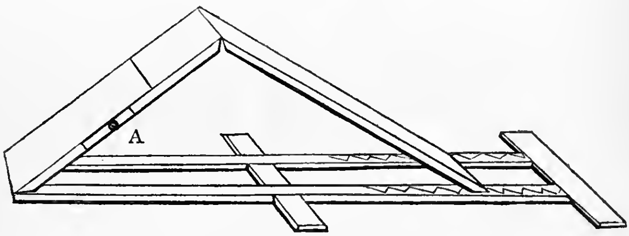
position to spasm still existing. And it now remains to be seen, by what means these two important points can be obtained.

The above advantages are gained by a very simple apparatus, called the double-inclined plane. It consists of two pieces of wood, fastened by hinges to a third or horizontal piece, which rests upon the bed, while the other two form an angle with one another for the thigh and leg to rest upon. This apparatus was first advocated by Sir Charles Bell, who has distinctly laid down the importance of employing it in fractures of the shaft of the bone. He says, "Thus, in fractures, I have laid it down as one of your rules, that when you cannot bring the lesser portion to the greater, you must so contrive it that the body of the bone shall follow the detached portion. * * * * It is now about eighteen years since I have been accustomed to shew the application of the double-inclined plane to fractures of the thigh bone, that it relaxes the muscles inserted into the trochanter minor, and at the same time relaxes all the muscles on the back of the thigh, by the bending of the knee; in short, that it humors the natural position of the limb; and that instead of having to restrain and bring down the upper portion, the lower part is raised to correspond with it."*

The kind of plane that is most generally employed, consists of a frame-work of wood, which is placed upon the bed, to which are attached two other pieces of board with hinges, so as to leave the lower end of one of them moveable, to allow of it fitting into notches made in the frame-work, by which the angle of the plane can be altered at pleasure, by moving this portion backwards or forwards, as may be required. The sides

* Observations on Injuries of the Thigh Bone, 4to. 1824.

of the two portions on which the thigh and leg rest, are perforated with holes to fit pegs into, to steady the limb and to prevent its falling off. The wood-cut represents it. The letter A marks the screw that fixes a slide in the thigh portion of the plane, to allow of it being adapted to limbs of different lengths. This addition, I believe, was first made by Mr. Amesbury, and it is a great advantage gained, for then the apparatus can be fitted exactly to the size of the limb for which it is employed.*



When the inclined plane is made use of, all the advantages of the treatment by position are gained, while the objections are obviated that are met with when Pott's position of placing the patient on his side is adopted. The only difference between the two methods is, that when the double-inclined plane is used, the patient is made to lie upon his back, while in the other he lies upon his side. But the advantage of the former position is, that the patient does not become fatigued, and can lie for a great length of time without its becoming so irksome to him, as must necessarily be the case when the latter position is put into practice. The same principle is also still preserved, which will be

* The above drawing was taken from the double-inclined plane in common use at the Middlesex Hospital. It is of the most simple form, and I believe possesses all the advantages that the more complicated ones are said to have.

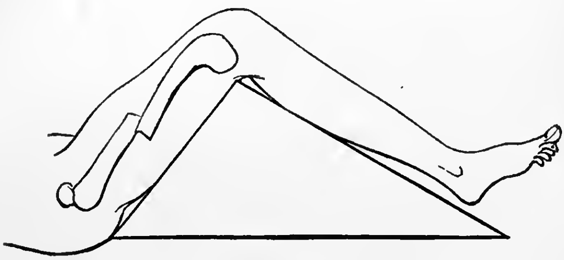
evident when the position of the limb is examined; for the hip and knee joints are flexed by the angle the plane forms, and consequently all the muscles will be relaxed in the same manner as they are when the patient is placed upon his side; and all disposition to spasm is prevented, and the portions of bone allowed to be easily brought into contact, and into the same line with one another, by raising the lower portion to the same level with the upper. The psoas magnus and iliacus internus are relaxed by the flexion of the hip, and the ham-string muscles are relaxed also by the flexion of the knee. But there is a mechanical advantage derived by the inclined plane, that cannot be got by Pott's position, namely, the slight extension which the weight of the leg and foot produce, by having them placed over the lower part of it, at a different angle with the thigh, so that the knee forms a fixed point of resistance, and prevents the lower portion of bone being pulled towards the upper; and the tuberosity of the ischium pressing against the upper end of the plane, prevents the pelvis pushing the upper portion of bone towards the lower; so that if the plane fit well, all retraction is prevented, and without the employment of any violence. Another advantage gained by it is, that the position of the fractured ends can be easily ascertained; for the anterior part of the thigh can be readily examined by making pressure upon it, and feeling if one portion be more prominent than the other; and should there be any riding of the upper upon the lower, the deformity can be remedied by either lengthening the thigh part of the plane, or by altering the angle of the knee. The bone may be further steadied by placing a long and firm lath splint upon the anterior part of the thigh, extending from the groin to the knee,

and another on the outer and inner side down to the condyles, and fixing them by means of three tapes or straps. The abductor muscles are sometimes disposed to act, and pull the upper portion of bone outwards, and this often to an extent to cause a great prominence to exist in the situation of the displacement. This is also exemplified in some cases after union has taken place, when the outside of the thigh feels rounder than natural, and has a bowed appearance. When this is met with, it is generally owing to the upper portion of bone being brought into the above state of abduction, as represented in the wood-cut.

This kind of deformity is to be guarded against by pointing the inclined plane outwards, so as to bring the lower portion into the same line of abduction that the upper one is in, and accomodating the one to the other.

When the inclined plane is used, great care must be taken to see that the portion of it on which the thigh rests, corresponds exactly with the natural length the limb possessed before being fractured: and this point is to be ascertained by measuring with the opposite limb (provided there have been no previous deformity in it). The points from which the measurement is to be taken, are, the tuberosity of the ischium and the angle of the knee; and the plane should be applied to the sound limb first of all, to see that it corresponds exactly with the points above mentioned; for if it does, the fractured limb will be the proper length when placed upon it. The effect of the thigh-board of the plane being too short, will be obvious, namely, that the knee must approach nearer to the pelvis than natural, and push the lower portion of bone with it;

and the contact of the fractured surfaces being lost, will allow of the upper portion being tilted upwards, and then the lower one will be drawn behind, as well as beyond it. This is the most common evil that is liable to occur, if the plane be not the proper length. The deformity then produced is represented in the wood-cut.



A similar evil will also occur if the thigh part of the plane be too long, for then the knee will be dragged over the angle of it, and the fixed point which opposes the retraction being lost, the lower portion will be pulled down into the same position. Many who use the inclined plane, do not look sufficiently to the above points, and then of course the desired end is not obtained, and a very useful apparatus unjustly condemned.

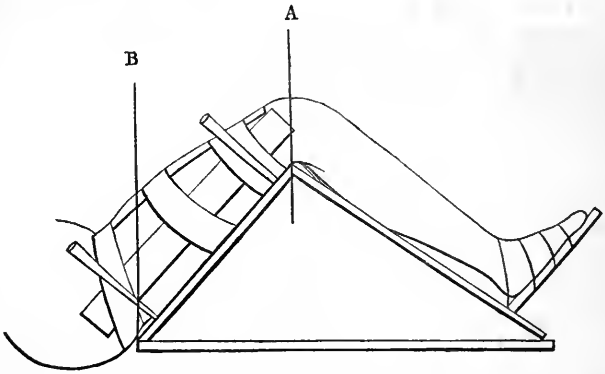
This correct adjustment of the length of the plane to the length of the limb, can always be obtained by the employment of the slide in the thigh board, for then it can be moved at pleasure according to the size of the limb, and any degree of extension be made upon it that may be required. Another advantage gained by the slide is, that the same apparatus will do for many different thighs, which those made of one continuous piece of wood will not, without the limb be exactly the same length. The mode of employing the inclined plane, is the following :—

A pillow is first of all to be laid upon it, long enough to extend from one end of the plane to the other, made of a substance that is capable of resisting pressure equally throughout its whole length. The ordinary pillows made with feathers are not so good as flannel, for they have no elasticity, and any long continued pressure upon them causes lumps and irregularities to form in them, which not only give pain to the patient, but alter the position of the ends of the bone, by allowing of one sinking below the other. Another objection to the feather pillows is, that they are obliged to be made so thick before they can act as a cushion, that the limb at first is put upon the stretch and will afterwards sink as the pillow sinks, and then the plane becomes too short. These evils do not exist when flannel is made use of to form the cushion, for it does not form into lumps, and yields as much at first as it will ever do, and consequently there need be no fear of future displacement of the portions of bone on his account; it also forms a more elastic cushion, and supports the limb generally underneath. The pillow of this kind is to be made by taking a piece of flannel of the length of the plane, and then folding it four or five times, or more, if the flannel be thin, and placing it on the plane, seeing that it protects that part of it against which the tuberosity of the ischium has to press, and that it lies quite even and smooth at the angle on which the knee has to rest. The plane is next to be applied to the fractured limb; the thigh is to be held by an assistant taking hold of the knee, placing the one hand underneath the ham, while the foot and ankle are grasped with the other; it is then to be raised up until it be at a sufficient height to allow of the plane being pushed underneath it, taking

care that it presses well against the tuberosity of the ischium. The knee is then to be lowered gradually, and when opposite the angle of the plane, the assistant withdraws his hand from beneath the ham, and then lowers the leg in the same manner, and places it on the lower part of the plane. The points then to be looked to are, to see if the angle of the knee and plane correspond, and if the ischium press well against the upper end of it, and the hand may be passed along the anterior surface of the thigh, to feel if any unnatural prominence exists, and if not, and if the above points are correct, the apposition of the ends of the bone will be proper, and they will unite without deformity being produced, if the limb be not again disturbed. The angle at which the plane is placed, will depend upon the disposition there may happen to be for the upper portion of bone to be tilted upwards, for the more it is disposed to rise, the greater angle the plane must take in bringing the lower portion on to the same level with it.

The limb may be further steadied, by employing three broad lath splints, placed on the outer, fore, and inner part of the thigh, extending from the groin, and great trochanter down to the knee and condyles,—they may be confined by three or four broad tapes or straps, —a foot-board may be also attached to the bottom part of the plane, seeing that it does not press against the limb too much, so as to push the knee from the angle of the plane. The leg is fixed to the plane by means of a bandage carried round it, and the leg part of the apparatus, and round the foot and foot-board. The thigh is prevented falling off the plane, by pegs that fit into the edges of it. The wood-cut represents the apparatus when properly applied. The lines, A,

B, show the two important points that are to be attended to, and to see that they correspond. A, the angle of the knee with the angle of the plane. B, the tuberosity of the ischium with the upper end of the plane.



The length of the fractured thigh can always be ascertained, after the inclined plane is applied, by measuring from the great trochanter down to the outer condyle, and then comparing it with the same points on the opposite side; and if the two correspond, the ends of the bone will be in apposition; provided there have been no injury previously in the opposite limb, to cause unnatural shortening to be present. I once saw a case of this kind, where the fractured thigh appeared to be of its proper length as compared with the other limb, but in which there could be distinctly felt some unnatural prominence. And it was very difficult to account for it, since, on measurement, the two limbs corresponded exactly. The man was subject to epileptic fits and almost idiotic, and died about six weeks after the injury—when there was found to be an old fracture in the opposite bone, the ends riding past one another in the same degree as on the recently

injured side; which accounted for the two limbs being of the same length, although the ends of the bone were riding. The patient himself never mentioned about his having received the previous injury. When any difficulty is met with, then, in accounting for any peculiarity that may exist with regard to the length of the two limbs, enquiries should be made as to the existence of any previous injury or deformity in either of them.

The simplicity of the inclined plane is an additional recommendation to it; for it can be procured in a very short time, and where the long splint cannot, by simply nailing three pieces of board together in the form just represented in the wood-cut. Care must be taken that the portion on which the thigh rests be of the exact length.

It will now be seen how completely the inclined plane obtains the end that Pott had in view when he first recommended what he called the treatment by position: for it relaxes all the muscles that tend to produce retraction of the one portion of bone upon the other; and allows of the easy reduction of the fracture, without the application of mechanical violence, and at the same time keeps the ends of the bone steadily in their place, and guards against future displacement. What has been said to those who object to Pott's position, may be equally well said to those who object to the inclined plane, namely, that "those authors pronounce the highest eulogium on it when they say, that to lay the thigh out upon a pillow, is to do no more than to commit the affair to nature."*

Scarcely more than this is done when the inclined plane is made use of; for the limb is then only placed

* John Bell's Principles of Surgery.

on a pillow, which is bent at right angles, without the employment of any mechanical violence, any more than the weight of the limb produces; the ends of the bone are quietly kept in apposition, and all stress taken from the muscles. There can be no doubt, that the more a fractured limb is left unconstrained, or, what some call, "to nature," the more beneficial it will be to it. At the same time, however, nature may be assisted, and the union of the bone be facilitated; for all the surgeon has in view, and in fact all he is capable of doing, is to place the limb in that position which brings the portions of bone into their natural line, and to keep them there, as much at rest as possible, and those means that obtain this end in the simplest manner are the best. This, however, differs greatly from that conclusion which some come to, by asserting that splints are altogether useless, and that they do more harm than good; for every one who has had much experience in the treatment of fractures, must know how contrary this assertion is to the fact. No doubt, that those who look upon the use of splints as being only to apply violence to the limb, are right when they say that they do more harm than good. But I conceive that there are very few surgeons who employ splints with this object, or with any other than that of simply steadying the ends of the bone after they have once been brought into apposition; and how much more good than harm they will do, must be quite obvious;—for if a limb can be better steadied with splints than without, and this in the majority of fractures is the case, the union must be facilitated, and a decided advantage gained by their employment.

Some make objections to the use of the inclined

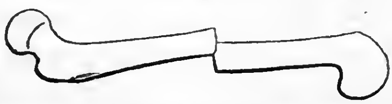
plane by saying, that the pillow upon which the limb rests, gradually becomes compressed by its weight, and particularly at the angle of the knee and tuberosity of the ilium. The consequence of which is, that the thigh becomes shortened, owing to the knee sinking and falling nearer to the pelvis, and taking the lower portion of bone with it, and thus producing the deformity represented at page 299. This is an evil that I have already considered, when speaking of the kind of pillow to be used for the limb to lie upon, and I then recommended the one made of layers of flannel, as being the best from its elasticity, and not becoming compressed in the above manner.

Another, and at first sight, a more plausible objection to the use of the inclined plane is, that the upper portion of bone and the pelvis, are not fixed so firmly to the lower, as they are when the long splint is employed, so that any motion of the pelvis will take the upper portion of bone with it, and leave the lower one behind, and so cause a deformity to exist. However possible this may be, the fact is, that it seldom if ever occurs, for there are only two directions in which the pelvis can be moved when the thigh is in this position; the one is laterally, by the patient shifting from side to side in the bed; the other is, that of turning the pelvis over so as to bring more pressure on the great trochanter than on the sacrum behind. Now neither of these alterations in position are probable; and for this reason, namely, that it requires a forced action on the part of the patient to produce them, which he will not be inclined to exert now that he is placed upon his back, and with the limb fixed in the manner in which it is on the inclined plane; for if the thigh-board be pushed well up against the ischium, and if the

lateral lath splints are firmly braced to the limb, both the pelvis and the two portions of bone will be sufficiently fixed, to guard against all displacement that can do the fracture any harm. The above assertion is true, as far as my own experience goes, for in no case that I have seen the inclined plane used, has this been an evil, where care and attention have been paid to its application, by seeing that it fit the limb properly. One important point to look to, is, to guard against motion of the pelvis, caused by the sinking of the mattress on which the patient lies, which should be firm and even, so as to keep the parts on the same level. A feather bed should never be used, for it will then be impossible to prevent sinking in some part more than another, and then all power of steadying the two portions of bone will be lost.

One of the advantages, as already stated, of the inclined plane over the long splint is, that the riding of the upper portion of bone upon the lower is so easily prevented, by being able to raise the lower portion to the same level with it. Now this cannot be done with the same facility when the long splint is used, and yet the limb may appear to be of the same length, without the ends of the bone being in correct apposition, for although the extension may be well preserved, the action of the flexor muscles of the hip cannot be altogether prevented; and although they cannot act to a sufficient extent to destroy the apposition of the ends of the bone completely, they may draw the upper portion upwards, enough to prevent them resting flat against one another, and to render the union of the two much weaker than otherwise it would be, and to require a longer time for the ends to become actually united. It may be said, that a strong splint, placed

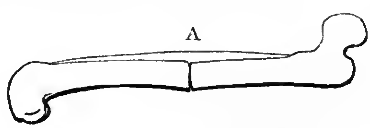
along the anterior part of the thigh, will be sufficient to guard against this evil. It may be, to prevent any very great deformity, but still the flexor muscles can act to a certain extent; for the muscular substance against which the end of the bone presses, will yield sufficiently to allow of it being drawn slightly upwards, and though it be not completely out of contact with the lower. The wood-cut represents the kind of deformity I mean.



This displacement cannot exist, when the inclined plane is used, without being discovered, owing to the position of the limb allowing its anterior surface to be so easily examined, and any prominence felt that may be present; but when the long splint is used, it may exist and not be perceived, and is likely to be overlooked on account of the limb itself appearing of its natural length.

Another evil of the long splint, when the fracture is very oblique, is, that the apposition of the ends of the bone depends altogether upon the continued extension that is kept up, for the muscles are always disposed to act while the limb is in this extended position, and will take advantage of the slightest yielding of the bandages or straps that are employed to produce it; the consequence of which will be, that the bones may ride past one another for the extent of half an inch or an inch without being perceived, while the limb is surrounded with the splints and bandages, and which it will be amazingly difficult to prevent, when the apposition of the ends of the bone gains nothing by the locking of the fractured surfaces against one another, as they do

when the fracture is transverse; for when the obliquity of it is such as I am now speaking of, the ends of the bone do not give one another the least support.* When the long splint is employed, the under part of the bone is not evenly supported; for then the patient lies upon his back with the leg extended, and the two points that rest upon the bed are—the tuberosity of the ischium and the condyles of the femur; the intermediate portion of the thigh bone has merely the muscles pressing against it, which do not gain equal support from the bed, owing to the above points being more prominent; the consequence of which will be, that when the long splint is applied, with the bandage carried circularly round the limb, and with the anterior splint upon its upper surface, the two ends of the bone will be pressed backwards or towards the bed, when the fracture is near to the centre, and cause the natural curve which the thigh bone has forwards to be destroyed, and so produce a deformity in the limb and a weakness in it, when it comes to support the weight of the body. The wood-cut represents the position of the ends of the bone under these circumstances—the letter A marking the curve that the bone naturally has.



* Some surgeons say that the fractured limb should be made an inch or two longer than the other, to compensate for the stretching of the joints. This appears to me to be impossible, for it implies one of four things:—1st, either that the head of the thigh bone must be pulled from its socket;—2nd, either that the head of the tibia must be pulled from its contact with the condyles of the femur;—3rd, either that the astragalus must be separated from the lower end of the tibia;—4th, or that the fractured ends of the bone themselves must be sepa-

Mr. Amesbury attributes this alteration in the shape of the bone, which he says, "instead of forming a segment of a large circle, forms two smaller segments" to the mere act of extension. No doubt this may be one cause, but I think there is another which oftener exists, and which may produce it without the other acting at all,—I mean the absence of support to the posterior part of the thigh, and to the pressure of the bandage and anterior splint,—which will be sufficient to produce the above deformity, without any extension being made at all.

Now when the inclined plane is employed, this evil is guarded against altogether; for the whole of the posterior part of the thigh is supported, and the muscles pushed well up in the space contained between the tuberosity of the ischium and the condyles of the femur, so that the above depression cannot take place, and the natural curve of the bone will be preserved. An evil, however, that is liable to occur when the inclined plane is used, is œdema of the leg and foot; and this may become a great source of inconvenience, owing to the length of time it sometimes remains, and the difficulty there is in getting rid of it. It will be found I believe to depend, in the majority of cases, upon an improper adjustment of the plane, and not to be a necessary fault in the apparatus itself; for when the pressure upon the ham is allowed to be more than upon the rest of the limb, which it will very likely be where the feather pillows are used, or where the angle of the plane does not fit the angle of the knee, but presses against the upper part of the calf of the leg

rated from one another. Now the three first are not possible, and the fourth, if it could be done, should not be recommended, for it would be highly injurious to the union of the bone.

instead; the circulation will be impeded in the lower part of the limb, and œdema will be the consequence. When this is found to be the case then, the position of the limb should be carefully examined, and all unequal pressure that may exist should be removed. This œdema may also be guarded against by taking care that the foot is well supported on the foot-board, and that it does not drag upon the leg; the leg itself may also be evenly bandaged, from the toes upwards, which will tend to equalize the circulation and so prevent the œdema taking place.

Stiffness of the knee joint sometimes exists after being so long confined in the bent position, but the same evil often remains after the employment of the long splint, and in a worse degree, for it is now the absence of flexion that exists, and it is much easier to gradually straighten a limb that is stiff from being too much bent, than it is to bend one that has been too long extended, (provided there have been no disease of the joint); at least I have found it so in the cases that I have seen, where the two opposite positions have been employed. When the stiffness is dependant on the use of the inclined plane, it may be remedied, and often guarded against altogether, by gradually lowering the plane each day during the last week that it is employed, until the limb can be got quite straight, and then it may be removed altogether. This will be found to be a much better plan than that of suddenly taking the limb from the bent to the straight position, for often it cannot be borne, owing to the great pain it causes the patient The return of motion in the joint is to be assisted by the application of warm fomentations, and friction with some liniment, at the same time that passive motion is gradually given, by moving the leg backwards and forwards.

Some make objections to the long splint, by saying that the pressure at the groin and ankle are often such as to produce irritation of the skin, and even sloughing. I have seen these effects myself produced, but then I am sure it has been from want of attention to padding the parts sufficiently when this pressure tells, and not from any fault in the principle of the apparatus itself. To these objections to the long splint, Desault answers very justly, "What method is sheltered from reproach, if it be wrongly made use of? What treatment will not produce evil consequences, if ignorance and inconsideration mutilate it? A circular bandage, too tightly applied, mortifies the subjacent parts—must we, on that account, proscribe the use of circular bandages? An unskilful hand may open the axillary artery, in the operation for cancer—must we, on this account, never more search for the enlarged glands in the axilla?" No doubt any method may be abused, and then the evil consequences brought forward as objections to its employment; but the objections founded on such grounds will have little weight with impartial judges, and with those who look to the principle on which the method acts. Having described the application of the inclined plane, and the principle on which it acts, and having considered the advantages it possesses, and the objections that have been made to it; it remains to be seen in what cases it can be employed, so as to gain the former, and to guard against the latter.

As a general rule, I should say that all those fractures that occur below the lesser trochanter are best treated by the double-inclined plane; and that all those occurring above it will derive most advantage from the employment of the long splint; for in the former case, the action of the flexor muscles has to be

considered; while in the latter, no such action exists: but the chief thing then to guard against is the retraction of the lower portion of bone, which is produced by the action of the powerful muscles surrounding the hip. It will be seen by and bye, when I come to speak of fractures of the upper end of the thigh bone, that the inclined plane may then produce the evil that the long splint guards against; for the plane prevents the close co-aptation of the fractured surfaces, and has not sufficient power to prevent retraction, when the fracture is situated through the neck of the bone.

The inclined plane is equally applicable to fractures of the lower third, as of the middle of the bone; for here the long splint would have a tendency to take the fractured ends from their proper level, by not supporting the under part of the bone; besides, the extended position puts the ham-string muscles on the stretch, when they should be relaxed as much as possible, and which they will be when the inclined plane is employed, at the same time that the condyles and lower portion of bone are well supported. In all cases, where the limb is much bruised, or when the fracture is compound, the inclined plane is peculiarly applicable, and is the best means that can be employed; for it is impossible that the pressure requisite to confine the long splint can now be borne, owing to the injury done to the soft parts, rendering it necessary to leave a large portion of the limb free from any bandaging. By the use of the inclined plane the limb is left quite open and unconstrained, and ready for the application of such local remedies as may be necessary.

It sometimes, but rarely, happens that both thighs

are fractured at once; for it is seldom that a force tells upon both with sufficient violence to cause them to break; for one generally receives the shock alone, whether it be from the person falling from a height, or by having a heavy weight, such as a wheel coming upon the limb: but of course where circumstances allow the force to tell equally on both, they will both of them fracture as easily as one singly. It will generally be found when the two thighs are fractured, that one or both are compound; for it most frequently happens that the force that produces the fracture has been directly applied, and of a very violent nature.

The principle of treatment in these cases, is of course the same as when one thigh only is fractured. Instead of using the common inclined plane, one wide enough for both limbs may be employed. And in these cases it will be best, when they can be obtained, to make use of Earle's or Amesbury's bed; for they fix the pelvis more steadily (and which requires more fixing now that both thighs are broken), and allows of the bowels acting without the necessity of moving the patient.

The length of time necessary to keep the limb on the inclined plane, whether it be one or both thighs that are fractured, will be from four to five weeks, for adults; while for children, three weeks will be sufficient. In very old people, five or six weeks may be necessary. The treatment to be adopted after the plane is discontinued (having brought it gradually into the straight position, by lowering the plane daily, for the last four or five days of its employment), is to let the limb remain quite at rest for a week or ten days longer, before the patient attempts to get up; during which time the thigh may have three or four

lath splints placed around it, and a bandage to support the fractured ends and the muscles generally. Some slight passive motion may be allowed to the joints, by an assistant bending the knee and rubbing it, to get rid of the stiffness, if any remain. When the patient gets up, great care is necessary when he first begins to walk, to prevent him bearing unequally upon the bone, and so causing it to yield at the point of fracture. Until the callus be strong enough to resist great force, there will always be a tendency for it to bend, for two reasons—the one, on account of the natural curve the bone takes forward—the other, on account of the disposition of the patient to walk on his toes at first, from fear of placing the foot flat on the ground, which necessarily bends the knee, and causes the weight of the body to tell obliquely on the shaft of the bone, instead of perpendicularly. To guard against this, the patient should be told to place the foot flat upon the ground, and to walk upon the heel rather than the toes; and this position of the foot will be better secured by placing a splint behind the knee, to keep it from bending; for without the knee can be bent, there will not be much disposition to walk on the toes, but rather upon the heel. During the first week that the patient uses the crutches, the leg may be supported in a sling, passed round the neck and underneath the sole of the foot, so as to rest the limb occasionally, and to allow of the pressure being made gradually upon it. Two or three broad strips of soap-plaster may be placed round the thigh, and the lath splints be continued for the first ten days or a fortnight, and the whole limb be kept rolled from the toes upwards. By this means the muscles will be generally pressed upon, and spasm will be guarded

against, which might come on from their being out of use so long a time, and restrained by the callus. The lath splints will also give the patient confidence when he begins to use the limb, by his knowing that the part is supported; and he will then be less likely to make a false step, or to bear unevenly on the part. The length of time that it will be necessary to continue the use of crutches, must of course depend upon the strength in the bone, and the confidence and power of the patient to do without them.

In infants, or very young children, fractures of the thigh cannot be treated by the inclined plane, for there is not at this age sufficient weight in the body and pelvis to fix and steady the limb. The best treatment in these cases, is to place a small long splint along the outside of the thigh and leg, and to bind them to it, at the same time that a firm lath splint is passed along the anterior part, from above the groin down to below the knee; a thick pad will be required opposite the groin, to fill up the hollow that exists here in children, owing to the prominence and rotundity of the abdomen. It is sometimes difficult to prevent the upper portion of bone tilting up at this early age, and the only way of doing it is, by having the splints long enough to include the knee and hip joints, so as to prevent them from bending, by bandaging the limb firmly to them.

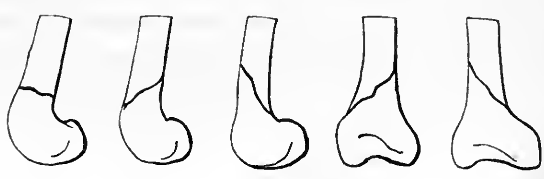
FRACTURES OF THE LOWER END OF THE FEMUR.

Under this head, I include the condyles, and the broad portion of the bone just above them; and I give a separate description to this part, as the fracture very often extends into the knee joint, or takes a direction

that produces symptoms differing from those of the shaft of the bone, although the treatment does not differ in principle.

The lower end of the femur expanding into the condyles, becomes of a different structure to the shaft of the bone, it being now of a loose cancellated nature, and no longer possessing the brittleness that the cylindrical shaft has. This circumstance combined with the different shape of this part of the bone, renders it much less liable to fracture than the shaft, and never to be fractured without a very violent force be applied to it. The kind of force that generally fractures the condyles, is a heavy weight falling upon them, or by the person jumping from a height and coming with the leg vertically placed, or in such a position that the whole shock comes upon the lower end of the femur, so as to split the shaft of the bone through the condyles, or else to separate the condyles themselves from one another.

Fracture of the lower end of the femur may take place without including the condyles, and may extend in many directions, and will produce various kinds of displacement accordingly. The wood-cut represents the different lines the fracture may take.



A B C D E

It may extend simply in a transverse direction, as represented at A, or it may be obliquely backwards, or forwards, or inwards, or outwards, as represented

at B, C, D, E. When it is transverse, the displacement is generally little or none, owing to the surfaces of the bone being so broad and being easily locked against one another. In the oblique fractures, and the one downwards and forwards, represented at B, in the wood-cut, is the most common; the displacement is often very great, and shortening of the limb is produced, and the ends of the bone ride upon one another; for now the lower portion of bone is easily acted upon by the powerful ham-string and extensor muscles of the knee, which pull upon the head of the tibia, and through it, upon the condyloid portion of the femur; and the direction which the displacement takes is generally to the side of the shaft on which the obliquity exists. When the fracture extends downwards and forwards, the sharp end of the shaft of the bone is felt beneath the tendon of the rectus muscle, and the lower portion is drawn backwards into the popliteal space; there is also free motion and a crepitus produced, when the limb is extended. When the fracture extends laterally, as in D or E, the displacement of the shaft of the bone will be to the side of the condyles on which the fracture is, and will be felt projecting there. The shaft of the bone, in all these cases, will be tilted slightly upwards; for the flexor muscles will still have some effect upon it, though it will not be very great, owing to the mass of muscle, and the weight of the leg that presses upon its lower end.

Sometimes when the fracture is very near to the condyles, it appears as if the condyles themselves were separated from one another, for the motion that can be given to them is very near to the joint, and the crepitus also, which it is difficult to ascertain the

exact position of. On making the examination very carefully, however, the direction and situation of the fracture can be discovered; for by grasping the condyles firmly, and endeavouring to move them in opposite directions, it will be found that no motion exists between them, but that it is in the shaft of the bone just above. Another symptom wanting is, the effusion into the joint, and the swelling consequent upon it; but this may exist sometimes, without the condyles being fractured, when the bone is split downwards and forwards, so as to open into the synovial membrane, where it is reflected under the quadriceps muscle; effusion and swelling will then take place in the same manner, owing to the joint being injured.

The muscles that tend to produce displacement in fractures of the shaft of the bone, have the power of doing so more or less, according to the direction the fracture has taken. The muscles most likely to act, are the ham-string muscles and the extensors of the knee, and the gastrocnemius which takes hold of the condyles. The action of the ham-string and extensor muscles will be, to pull the lower portion of bone upwards, by acting through their insertion into the head of the tibia, and will draw it behind or before the shaft of the bone, according to the direction the obliquity of the fracture has taken. The gastrocnemius will pull the lower portion into the popliteal space, when the fracture is downwards and forwards, so as to leave the shaft of the bone the most anterior part. The wood-cut represents the displacement.

I believe that the shaft of the bone in these cases of fractures near to the knee, is seldom moved much from its natural position, but that the chief displacement takes place in the condyloid portion, by the action of the muscles just mentioned; and the reason of the shaft being so little moved I have stated, namely, owing to the weight of the leg and knee which drags upon the tendon of the rectus muscle, and so presses the end of the bone down. The end of the shaft of the bone is sometimes driven through the muscle and integument, more particularly where the fracture extends downwards and forwards; for the weight of the body acting upon the end of the bone, after it has produced the fracture, may drive it through the soft parts and cause the injury to be compound. When the fracture extends downwards and backwards, the vessels in the popliteal space will stand a chance of being wounded; this, however, is the rarest direction for the fracture to take. The position of the leg and foot becomes altered in these cases, and will be either in a state of inversion or eversion according to the direction of the fracture, and the kind of displacement of the ends of the bone. The foot is more frequently, however, turned outwards, owing to the weight of the leg, and the shape of it favoring motion in this, rather than in the opposite direction.

The condyles of the femur are sometimes separated from one another, and from the shaft of the bone also; this kind of fracture, however, is much rarer than of other parts of the bone; but when it does occur, it is of a most serious nature, owing to the knee joint being included in the injury. The force necessary to fracture this part of the bone must be of a very violent kind, and may be applied so as to tell in three different ways:

1st, one or both condyles may be separated, by the patient falling with the limb obliquely placed, and the force may begin to act on the shaft, and extend afterwards so as to include the condyles. 2ndly, the force may be directly applied to them, so as to fracture them exactly at the point struck, as when a heavy weight falls upon the knee. 3rdly, the lower end of the femur may be split up, by the person jumping from a height, and so drive the condyles forcibly down upon the head of the tibia, and cause them to split up and to separate from the shaft of the bone: the latter is not an uncommon kind of accident in producing this kind of fracture.

In considering fractures of the condyles, the ligaments that are attached to them have to be considered also, for upon them depends the little displacement that generally takes place between them; for these ligaments become the antagonists to the powerful muscles that are disposed to draw the portions of bone apart, and which would do so, were it not for their presence. The muscles attached to the condyles, namely, the adductor magnus and two vasti, will be disposed to pull the portions of bone upwards, while the gastrocnemius will be disposed to pull them downwards. The ligaments that tend to counteract this displacement, are the capsular and the two crucial: the lateral ligaments will also prevent the portions of bone being drawn upwards. This fact causes most of the deformity that exists, to be produced by the end of the shaft of the bone projecting forwards, or else between the condyles, and so pushing them apart, the muscles themselves having very little to do with the displacement.

One of the diagnostic symptoms, then, of fracture elsewhere, is not present when the injury is through

the condyles; at least it is often not, and never to any very marked extent; namely, the displacement of the portions of bone. The motion between the two portions, and the crepitus, are not very distinctly produced, without the patient be seen at an early period, before the swelling has come on: and when these symptoms can be obtained, it is difficult to say how much is produced by the fractured surfaces of the condyles themselves, and how much by the lower end of the shaft of the femur.

The condyles must be firmly grasped, and endeavours made to move them in opposite directions; or the joint may be flexed and extended by an assistant, while the ends of the bone are held, and notice taken of any motion that may be produced. The fact of the crepitus alone existing must not be taken as a symptom of the condyles being fractured; for fracture of the shaft of the bone, very low down, will give a crepitus, which, being so near to the joint, might be mistaken for that of the condyles themselves. I once had an opportunity of witnessing a case of this kind, where a man fractured the femur obliquely, just above the condyles, in which there was very little displacement of the ends of the bone. I saw the man immediately after the injury, and found the fracture in the above situation; there being no injury done to the condyles; which point I particularly examined, by endeavouring to move them in opposite directions, and by getting an assistant to extend and flex the knee joint; under neither of which circumstances could the least motion be got between them. The man was seen, some hours after, by the surgeon under whose care he came, who said at once that the case was one of fracture of the condyles. My opinion at the time was, that this was a wrong

diagnosis, both from the examination I had made immediately after the injury, as well as the absence of all swelling; and it proved to be so by the termination of the case, for the man recovered in the usual time, and without a single symptom of inflammation of the joint, and without the slightest impediment to the motion of the part afterwards.

In fracture of one condyle only, there is no more displacement than when both are the seat of the injury; for the ligaments connected with it still have the power of retaining it in position. There is one fracture, however, where there may be displacement to a partial extent, although a large portion of the bone still remains in contact with the tibia. This occurs when the shaft of the bone is broken, so as to take the form of a wedge, which it now and then does; it may then be pushed forcibly between the two condyles, and so cause them to be separated from one another at their upper parts; and they will be more or less so, according to the degree of violence with which the force is applied. The outer edge of the condyle may still remain in contact with the head of the tibia, being kept there by the capsule and lateral ligaments. The wood-cut

shews the kind of fracture meant. It is, however, very rare, and can only be produced by a very violent kind of force, telling vertically through the head of the tibia; or by the condyles themselves being crushed. The usual direction for the fracture to take, as already stated, is, for the shaft of the bone to break rather obliquely downwards and forwards, while the condyles are split vertically upwards.

The fracture may extend partially through the con-

dyle. I have seen one case of this kind in a boy, who had the leg crushed on a rail-road. The head of the tibia was broken into a great many small pieces, and the inner condyle was found to have a fracture extending through its substance for the extent of three-quarters of an inch; which was ascertained after the boy's leg was amputated. In these cases of partial fracture, of course there are no symptoms to indicate its existence, for there can neither be motion or displacement.

TREATMENT OF FRACTURES OF THE LOWER END OF THE FEMUR.

The principle of treating fracture of the condyles, or of the shaft of the bone immediately above them, is the same as that of the shaft of the bone elsewhere, namely, to place the limb in that position which tends to relax the muscles, whose action would be disposed to cause displacement by pulling upon the fractured portions of bone. The treatment by extension in these cases I think bad, and for these reasons:—1st. The fracture is generally very oblique, whether it include the condyles or not; and it generally extends downwards and forwards, so leaving a disposition for the lower portion of bone to fall into the popliteal space; the consequence of which is, that support is wanted from behind, to keep the fractured surfaces in contact, which the long splint will not do. 2nd. The muscles have more power over the lower portion now, to what they have when the fracture is higher up; and the straight position only tends to make them exert this power, by putting them into spasm as soon as they are pulled upon. 3rd. When the fracture extends into the joint, it will be decidedly injurious to make extension upon

the limb; for the more the portions of bone are pulled upon, or the soft parts around them, the more will the inflammation, that must necessarily be produced, increase. The treatment best adapted to these cases, is that employed in fractures of the shaft of the bone, namely, the double-inclined plane; for it obviates all the evils that I have just enumerated as likely to occur when the long splint is made use of. The inclined plane supports the posterior part of the thigh, and will so prevent the fractured ends pressing too much into the popliteal space; at the same time that the weight of the leg, telling upon the lower part of the plane at a different angle, will have a disposition to raise the fractured end, instead of tending to depress it, as the extended position does. The flexion of the knee also relaxes the ham-string and gastrocnemius muscles, and removes all stress from the condyles, and guards against displacement; at the same time that the two portions of bone can be brought exactly on the same level, by altering the angle of the plane as circumstances may require. When the fracture is through the condyles, the inclined plane supports the joint at the part where it is best able to bear the pressure, namely, the posterior part; while the rest of it is left free and unconstrained, and open for the application of local remedies.

When the fracture is compound, by the end of the shaft of the bone being driven through the soft parts, the wound is generally situated at the anterior part of the limb, and can be easily dressed when the inclined plane is employed.

If the compound fracture extend into the joint, and have been produced by the direct force, it may become a question as to the propriety of amputating, rather

than attempting to save the limb. No decided rule, however, can be laid down in these cases, as to those in which amputation ought to be performed, and those in which it ought not; for there may be circumstances attending one case, that do not exist in another—such as the nature of the force being different that caused the fracture; the degree of injury done to the soft parts; and the strength of constitution the patient may have, to bear up with a long and tedious confinement to his bed, which he must go through before he can recover; and with a great drain upon his system, from the discharge that generally attends the inflammation that comes on in these cases. As a general rule, it will be found that the majority of cases of compound fracture into the knee-joint require amputation immediately; and more particularly when the injury has been caused by the direct force—such as a heavy weight falling upon the part, or from a kick of a horse. There are no particular rules for the application of the inclined plane in fractures of the lower end of the femur, more than those laid down when speaking of fracture of the shaft of the bone. One precaution, however, that is necessary, is to see that the foot is well supported on the foot-board, so as to take off all straining from the knee joint, and to prevent the leg and foot dragging upon the condyles, and so increasing the inflammation. The local means are required to be very active, owing to the joint being injured, and very prone to take on inflammatory action. Cold lotion or ice may be applied, and kept on as long as the kind of inflammation present will admit of it; but when suppuration commences, hot fomentations and poultices must be substituted, and be continued until the wounds admit of being dressed. The application

of ice during the first stage is often of the greatest benefit, by keeping down the action of the vessels, and preventing the inflammation reaching that height which it otherwise might do.

As soon as the swelling and inflammation have subsided, the joint may be supported by means of strips of soap plaster, evenly applied, so as to give gentle pressure and to steady the fractured portions of bone; for it is of the utmost importance to keep the joint at perfect rest. About the end of the third week, if every thing have gone on favorably, the limb may be removed from the inclined plane, and put into the straight position; for the fear in these cases of fractures into joints is, that the motion may be impeded owing to the inflammation that has been going on, causing thickening in the various parts, and a consequent stiffness when the muscles come to act, which often remains for a long time after the union of the bone has taken place, and without any deformity existing in the joint itself, from the portions of bone not being in proper apposition. Passive motion may be given in these cases, by gradually flexing and extending the joint, and rubbing it also with some emollient liniment. When the patient begins to walk, the whole limb must be evenly rolled from the toes upwards, and a firm splint placed behind the knee, to prevent the joint giving very suddenly, which it will be inclined to do, until the patient has gained strength and confidence enough to walk without the aid of crutches.

If the fracture through the shaft of the bone be very oblique, it will not be safe to let the patient bear his weight upon the limb at so early a period as he might do if the fracture were transverse; for, in the former case, all the strain comes upon the callus; while in the

latter, the ends of the bone themselves take a great part in resisting it, owing to their locking against one another, which they cannot do when the fracture is very oblique. It will be safer in these cases to wait some time longer, to allow of the callus gaining an additional degree of firmness, and a greater power of resistance.

FRACTURES OF THE UPPER END OF THE FEMUR.

By the upper end of the thigh bone, I mean all that part of it situated above the trochanter minor, including the round head of the bone, the neck, and the great trochanter. Fractures of this part of the femur require a separate consideration, for the symptoms produced are different, and the treatment that is required is also different, owing to the influence of a class of muscles being removed from the upper to the lower portion, namely, the flexors of the hip; for the fracture being above the lesser trochanter, causes the insertion of the psoas and iliacus muscles to be connected with the shaft of the bone, and to exert all their action upon it, leaving the upper portion of bone quite free and unaffected by it.

The head of the thigh bone is seldom fractured; for its shape gives it strength, and it is protected by its mode of articulation with the acetabulum. The neck of the bone is the part most frequently fractured of this portion, above the trochanter minor, owing to its shape and situation often exposing it to injury, and enabling a force to act easily upon it. The trochantral portion by itself is not unfrequently fractured, but it requires a very violent kind of force.

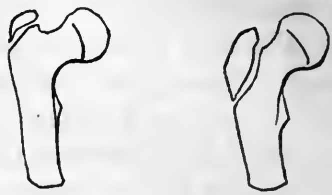
The neck of the thigh bone is the part that possesses the most interest, both on account of its fracture occurring more frequently, and of the great difference of opinion that exists, even up to the present day, as to the possibility of bony union taking place here as in fractures through other parts of the bone; for many very high authorities assert one opinion, and many equally as high assert another;—one saying that such bony union does take place, the other that it never does. It is not my intention to enter into a discussion of these various opinions, further than is necessary to consider those points that appear to bear most upon the subject, and to ascertain how far the facts on which these various opinions are formed, are sufficient to support the conclusions that are drawn from them. This, however, I shall defer until I have considered the symptoms and treatment of the fractures of this part of the bone, and shall introduce the observations I have to make upon the subject, under the head of "Prognosis of Fractures of the Neck of the Femur." I shall first consider the fractures through the great trochanter.

Fracture of the great trochanter does not occur so frequently as that of the neck of the bone, and it requires a force to be directly applied to produce it, if the trochanter alone be fractured; but if it extend through the shaft, the force may tell through the neck of the bone first of all, or it may pass upwards obliquely through the shaft and come upon the trochanter afterwards. A very common way for fracture through this part of the bone to occur is, by a person falling and striking the trochanter against some hard projecting substance, as the edge of a step or the curb stone. The direction the

fracture takes varies very much; it most frequently, however, extends so as to include a portion of the neck of the bone and of the trochanter minor, at the same time splitting the two trochanters from one another, and allowing of the neck of the bone being wedged in between the two; in which position it is often so firmly fixed that it is impossible to make extension sufficient to unlock the portions of bone from one another. The wood-cut represents the kind of fracture.

The fracture sometimes extends in a transverse direction, it may also take any degree of obliquity, being downwards and outwards, or downwards and inwards, and either single or comminuted. These points, however, are of very little practical use, for it is almost impossible to tell the exact line the fracture may have taken through so thick a part of the bone, and where at the same time it is generally split in more directions than one;—it neither influences the treatment or the mode of applying the force to make the reduction. The only direction of the fracture which admits of being easily discovered, is the one that extends transversely across the upper part of the trochanter, so as to separate the upper portion of it from the rest. When this kind of fracture occurs, the part that is broken off may be easily moved, owing to its situation and the small size of it allowing of its being felt, and not becoming locked into the rest of the trochanter. It is very seldom, however, that this kind of fracture exists; for the force applied is generally of so violent a nature, that the bone is broken into many pieces, and in a direction that causes them to be locked firmly against one another. It is quite possible, however, that the tro-

chanter may be so separated, and in two different directions, as represented in the wood-cut; the one where the upper end of it merely is broken off, the other where the fracture extends deeper, so as to include the root of the trochanter as well. The symptoms will be such as might be expected, when the muscles attached to this portion of the bone are considered; for the glutæus medius and minimus will tend to pull it upwards, and if the tendinous expansion that they form at their insertion be torn through, they will have the power of doing so, and will cause displacement upwards; at the same time that the fractured portion is found to be moveable, and if the surfaces are in contact, the motion will be accompanied with a crepitus.



Where the fracture takes a direction between the two trochanters, so as to wedge the neck of the bone in between the two, the symptoms may be such as to influence the position and shape of the whole limb, for there will be shortening to a greater or less extent, according to the degree of force that has been applied at the time of the accident, so as to drive the portions of bone past one another. If the shaft be separated from the neck completely, so as to meet with no resistance, the muscles will be likely to act upon it, but in a different manner to when the fracture is below the lesser trochanter; for now the class of muscles that in the latter case act upon the upper portion of bone, will act upon the lower instead, owing to their insertion being connected with it; they will therefore be disposed to pull the shaft of the bone upwards and forwards, or to bring it nearer to the spinous process

of the ilium, at the same time that it is retracted above the upper portion, by those muscles that pass from the pelvis down to the knee; the foot will also be turned outwards, owing to the weight and shape of the leg favoring eversion rather than inversion; the rotators outwards have now no effect upon the shaft of the bone, for their influence is destroyed by the position of the fracture. The upper portion of bone is scarcely at all acted upon by the muscles in these cases, even when the direction of the fracture leaves some of their insertions connected with it, for it is generally so wedged into the shaft, that it becomes mechanically fixed, and requires great violence to displace it.

The most frequent position then for the limb to be displaced in, when the fracture extends through the trochanter, is for it to be drawn upwards and outwards, so as to produce shortening and eversion. The trochanter itself, will also be found nearer to the crest of the ilium than natural, and will have lost its defined shape, feeling like a thick mass of bone, and not presenting any distinct prominence as it does when no fracture exists. This increased thickness, together with the displacement of it forwards, is an important point to observe, for it will help to distinguish between fracture of the neck of the bone simply, and those cases where the trochanter is included as well.

When the trochanter is fractured, it may happen that at first there is no shortening of the limb, and that the displacement does not take place till sometime afterwards. There are many reasons given for this: it is said that it is owing to some portion of the capsular ligament giving way, which had previously held the fractured ends in contact; or to some accidental

movement of the patient unlocking the fractured ends, and then allowing the muscles to pull upon the lower portion of bone, and to drag it upwards; and the latter cause is perhaps the more probable one of the two.

The crepitus is a symptom that is not always easily obtained in fractures through the trochanter, for the direction of the fracture is frequently one that admits of but little motion between the ends of the bone, but causes them to be firmly locked together.

When the wedgelike fracture is produced, and which, as already stated, is by far the most frequent kind of fracture through the trochanters, it is often very difficult to produce a crepitus, for the fractured surfaces are generally not sufficiently detached to admit of motion between them, so as to allow of one rubbing against the other; when the shaft of the bone is moved, the other portions of bone move with it. The crepitus, however, can sometimes be produced by extending the limb forcibly, and then giving it a sudden twist or rotatory motion, and the more suddenly it is done, the more likelihood there will be of disengaging the fractured surfaces, and of producing the friction of the one upon the other.

In some cases the crepitus can be produced without the necessity of making extension on the limb, but by merely rotating it. This is of course presuming that the fractured surfaces are partially or completely in contact, for it sometimes happens that the displacement which occurs, is sufficient to destroy this contact, either owing to the retraction of the muscles, or to the force that produced the fracture being so great, as to drive the shaft of the bone from its contact with the upper portion. If the extension and rotation of the

limb do not succeed in obtaining the crepitus, it may sometimes be got by taking hold of the knee and raising it so as to flex the hip; this flexion may cause the fractured surfaces to grate upon one another, though the other means may have failed.

Fracture is said sometimes to take a direction more or less obliquely through the great trochanter, towards the trochanter minor. This kind of fracture no doubt is possible, but I think it seldom occurs; for the force applied, will either fracture the neck of the bone, or else be sufficient to break the bone into many pieces, and not likely to extend in a simple line through so thick and spongy a part of the bone as this is. When it does occur, however, the symptoms will be more apparent, the more oblique the fracture is, for the more displacement will then take place. When the fracture extends transversely across the root of the great trochanter, just above the lesser trochanter, the displacement need not be much by the action of the muscles, without the force applied has pushed the fractured surfaces from their line of contact; whereas if the direction of it be oblique, the contact of the two ends of the bone may be destroyed by very slight muscular action, either from spasm, or from the attempts of the patient to move the limb.

FRACTURES OF THE NECK OF THE FEMUR.

Fractures through the neck of the femur occur much more frequently, than through the trochanters. It is an accident that is met with chiefly in old people, and very seldom indeed in young. The structure of the bone in old people becomes altered, owing to the deficiency of the animal matter in it, causing the earthy

to be in excess, which gives a brittleness to it, that does not exist in the bones of young people. This part of the bone is also naturally of a loose, cancellated structure, and when deprived of its animal matter will become weak, and ill calculated to receive any severe shock, either from the weight of the body, or from a blow directly applied to the part. There are other causes also which tend to produce fracture of this part of the bone. The muscles surrounding the hip joint in old people waste, causing this part to become flattened, and to have comparatively little covering upon it; so that a fall upon the posterior part of the hip, which in a younger person in whom the muscles act as a cushion might tell with little force directly on the trochanter, or neck of the bone, would in an old one, where this cushion is absent, be sufficient to produce fracture. In old people also, the whole body loses its elasticity, all the movements are heavier, and more awkward, and less secure, so that falls are likely to take place from trifling causes, without the power of resisting them; for though a younger person might break his fall by the use of his arms, or by the strength and activity of his body generally, an old person cannot, but falls like a dead weight, and the shock of course becomes much greater than it otherwise would be. All these circumstances taken together cause this kind of fracture to be much more frequent in old than young people.

This fracture is found to occur more frequently in old women than in old men. The reason of this I believe to be dependant on many causes:—1st. Old women are more liable to fall than old men; for, comparatively, they are much more infirm, and much less secure on their feet than old men. 2nd. Their bones

are also of a smaller make, and naturally weaker than in men, which will render a force more capable of acting upon them. 3rd. The position of the neck of the femur is different in women; for the width of the pelvis is greater, and the neck of the femur is longer and more transverse; which will cause the trochanter to be more prominent, and to be more exposed to receive shocks upon it during falls, or otherwise.

The causes, then, of the frequency of fracture of the neck of the femur in old people rather than in young, may be divided into two kinds, namely, the proximate, and the remote or predisposing. The proximate, or immediate, is the greater frequency of falls in old than young people; while the predisposing cause is the alteration in structure of this part of the bone, which renders it more brittle, and less capable of resisting violence.

The force that produces this kind of fracture may also be divided into two kinds, namely, the direct and the indirect. The direct force is generally applied by a fall upon the trochanter, either laterally or posteriorly, and most frequently the former; while the indirect is generally produced by the weight of the body telling upon the neck of the bone, where the force from below drives the head of the bone up in a contrary direction against the acetabulum, as when a person makes a false step, in fancying he has come to the ground in going down stairs, or while walking on any irregular surface, and the heel comes suddenly and forcibly upon the ground; a violent shock is then thrown upwards upon the hip joint, which in old persons is sufficient to cause the neck of the bone to give; and in them is a very common cause of this kind of injury.

The direction which fracture of the neck of the bone takes, depends upon its situation; when it is near to the trochanter it may extend in more directions than one, and is generally oblique, passing through a portion of the trochanter, so as to include it in the fracture; on the other hand, when it is situated near to the head of the bone, it is almost always transverse, so as to be confined completely to the neck of the bone, leaving the trochanter uninjured. This difference in the two fractures, will shew in the one case, namely, in the fracture through the neck of the bone near to the round head, that it is confined to the capsular ligament; while in the other, although the neck of the bone may be fractured, the fracture will extend external to the capsule as well, owing to the direction it takes through the trochanter. This is a most important distinction to make, for I shall presently shew, that upon it depends the true explanation of the cause of the non-union in the one kind of fracture, while in the other bony union frequently occurs, and the patient recovers with a strong and useful limb. It is owing to the want of strict attention to this point, that the many different opinions that exist with regard to it, are still held; for it will be found, that even up to the present day, there are two opposite opinions existing, one asserting that bony union never can take place, and the other, that it always can, if proper means are taken to procure it.

Some authors subdivide these again into those fractures where, although completely within the capsule, the synovial covering round the bone is not torn through; and into those where it is; the same distinction is also made in the fractures extending externally to the capsule. I shall not dwell much upon

this division, for I conceive it to be next to impossible for it to occur; for when we consider the delicacy of the synovial periosteum which covers the neck of the bone within the joint, and the force that is necessary to be applied in order to produce the fracture, it will hardly be possible for the neck of the bone to be broken, without the membrane covering it being torn also, either partially or completely, and the latter no doubt most frequently takes place.

It appears to me, that even if this distinction do exist, that it is quite useless; for allowing that fracture can take place without the periosteum covering the bone being torn, how can we know that fracture at all exists?—for this state of things implies that no displacement has taken place, but that the apposition of the ends of the bone is as perfect as if no injury had been inflicted; which apposition must remain constant, in order that the thin synovial membrane covering them shall not be torn; consequently we cannot have the least symptom to indicate the existence of fracture, for there will be neither shortening of the limb, motion of the fractured surfaces, crepitus, or any eversion of the foot, or other deformity in the shape of the limb, that will lead to the idea of a solution of continuity in the neck of the bone. For as soon as one of these symptoms exists, so soon must the close apposition of the ends of the bone be disturbed, and then the synovial membrane must be torn through.

The only distinction necessary to make, is with those fractures where the external thick capsule is uninjured, the fracture being confined within it, and with those where it extends externally, the capsular membrane being injured to a greater or less extent, according to the degree of force that produced the injury. It does

not follow, however, that in the former case, because the fracture does not extend through a portion of the bone external to the capsule, this membrane itself should not be injured; for the force may have been so violent, that after breaking the neck of the bone, it has driven the shaft upwards to a great extent, and so caused the capsule to be torn through. Again, in the latter case, although the fracture extends through the bone external to the capsule, the capsular membrane itself may be but slightly wounded; for the force applied to cause the fracture, may have been sufficient to destroy the continuity of the bone, and yet not enough to push the ends of the bone asunder to any great extent, so as to cause the ligament to be torn through. This I think an important point to consider, for it not only influences the union of the fractured ends of the bone, but it also makes an important difference with regard to the symptoms that may be present; for when the capsule is but slightly injured, or not at all, the displacement of the portions of bone cannot take place to the same extent, that it can when it is lacerated either completely, or in such a manner that the ligament no longer has any influence over the position of the ends of the bone.

The symptoms of fracture of the neck of the thigh bone, are many of them the same as those of fracture through the trochantral portion of the bone, but they often exist to a more marked extent, and have some peculiarities that are quite distinct.

When the fracture is within the capsule, and unaccompanied with laceration of this ligament, the symptoms are not so marked as when the fracture extends external to it, and when the capsule is much torn; for as already stated, the ends of the bone cannot be

separated to so great an extent in the former, as in the latter instance.

The symptoms to be looked for in fractures of the neck of the bone, are shortening of the limb, eversion of the foot, motion between the fractured portions of the bone, with the production of a crepitus, great pain about the joint, and inability to move the limb, or to bear the weight of the body upon it. I shall consider these symptoms separately, and mention the peculiarities that exist with regard to each of them, for it will be found that many of them exist, and are easily ascertained, while some of them are often absent, and when present, are not decisive as to the injury being fracture.

Shortening of the limb is one of the most important symptoms when found actually to exist; I say actually, because a limb is often supposed to be shorter than another, when it is only owing to the position the patient is lying in. The first thing to be ascertained is, that the pelvis is placed quite straight with regard to the transverse diameter of the body; for any obliquity in this direction will give a corresponding obliquity to the lower extremities, and cause one to appear longer than the other. The pelvis being quite straight, the two knees ought to correspond, and the two heels also, if both limbs are of the same length. In order to ascertain this point with regard to the length of the two limbs, measurement must be taken in the following manner:—Place the patient quite straight in the bed, taking care that the shoulders and pelvis are parallel to one another; then feel for the anterior superior spinous process of the ilium, and for the upper edge of the patella, and measure the distance between these two points with a piece of tape or

string—first of all, on the injured side, and then on the opposite; and observe any difference that may exist between the two: if the fractured portions be riding past one another, there will of course be shortening, owing to the knee being drawn up towards the pelvis, and the degree of shortening will be indicated by the difference in the length of the distance between the above points, as compared with that of the sound limb. The distance between the prominences of the great trochanter and the condyle will not serve as points of measurement in these cases, as it does in fractures of the shaft of the bone; for the fracture may extend through the neck of the bone without including the trochanter, when of course the shaft of the bone itself will remain of its natural length: and the shortening will be between the neck of the bone and the condyles instead. Another measurement that may be taken, in order to ascertain if the neck of the femur be fractured, is from the anterior spinous process to the extremity of the great trochanter; when, if there be any displacement of the shaft of the bone upwards, owing to the fractured ends riding, the distance will be less than on the opposite limb, owing to the whole shaft of the bone being pushed upwards. This latter measurement, between the trochanter and the spinous process of the ilium, is a much surer indication of the shortening being dependant on the neck of the bone being fractured, than the former one; for if it be ascertained that the trochanter itself is not fractured, and that it is continuous with the shaft of the bone, any displacement that exists must be owing to the neck of the bone having given way, and to the shaft itself being pushed up towards the pelvis.

Measurement of the limb however, by itself, must not

be taken as a sure indication that fracture exists; without the surgeon have previously satisfied himself that this shortening is not dependant on other causes—for dislocation upwards on the dorsum of the ilium will bring the great trochanter nearer to the crest of the bone than natural, or a fracture through the shaft of the bone may produce shortening of the limb, and cause the distance between the spinous process and the knee to be less, if these points only be measured from; or the bones, generally, may be affected with rickets; and the thigh of the injured side may be more curved than the opposite one, and so cause a difference in the measurement of the two; and, finally, the pelvis itself may be distorted, so as to bring the trochanter nearer to the crest of the ilium, and cause the distance between the two points to be less, without there being any solution of continuity in the thigh bone itself. All these circumstances may exist, and give the appearance of the limb being shorter than natural, and still there may be no fracture through the neck of the bone; and I merely mention these as points to be borne in mind, when there is any difficulty in forming the diagnosis of these injuries about the hip joint; which sometimes present so much obscurity, that it is by no means easy to ascertain the true nature of them. If any doubt still remain as to the cause of the shortening, the patient should be questioned as to his having received any previous injury about the hip joint, or thigh bone, which might account for the present deformity that exists.

The position of the foot in fractures of the neck of the thigh bone, is one of the surest diagnostic symptoms; for it is almost always found to be in a state of eversion: instances are on record, however, of it

having been turned inwards. I have seen one case of this kind myself, and two others where the foot was turned directly upwards: these, however, are the exceptions, and not the general rule. It is difficult to account for the inversion of the foot in these cases when it does occur. Some suppose that it is owing to the fracture having taken such a peculiar direction, that a set of muscles are enabled to act upon it, that tend to turn the limb inwards rather than outwards; and preventing those muscles taking effect that generally turn it in the latter direction. This I do not think to be the true explanation of this peculiarity that is met with; for the muscles have little disposition to act, and more particularly to turn the thigh inwards; for it requires a forced and very powerful action to do so, owing to there being so very few muscles that are ever capable of producing rotation in this direction, the majority of them being rotators outwards. The true cause of the limb taking this peculiar direction, I believe to be owing to the portions of bone being sometimes so locked within one another, by the force that produces the fracture, that neither the weight of the limb, nor the action of the many muscles that would tend to produce eversion, have any power of doing so; and the ends of the bone remain fixed in the original position into which they were displaced at first. Another cause not unlikely to act, is for the upper end of the shaft of the bone to be driven through the capsular ligament, and to become entangled with it in such a manner that it cannot be turned outwards until extension is made, so as to bring the bone down again, and to free it from the position it has been placed in.

The eversion of the foot, as already stated, is the

most common position that is met with in fractures of the neck of the bone; and this, no doubt, is dependant on the same cause as that which produces it in fractures through the shaft of the bone, namely, the shape of the limb, which disposes it to roll outwards rather than inwards; and which it easily does, by the weight of the leg and foot acting upon it, now that they have lost their support from the upper part of the thigh bone.

Motion of the one portion of bone separately upon the other, in fractures of the neck of the femur, is not easily produced; for when the round head of the bone, and the free motion it has in the acetabulum are considered, it can be understood how the least locking of the fractured surfaces together will cause them both to move at once, and prevent the shaft of the bone rubbing against the upper portion: it is on this account that it is often difficult to get the crepitus, for without the fractured surfaces move one upon the other, no grating sensation can be produced, but the two move together, and the lower portion follows the upper into whatever position it is placed. In the majority of cases, however, the crepitus can be obtained either by moving the limb about in the position in which it is found, or by first of all making extension upon it, so as to pull the lower portion of bone downwards, and to bring the fractured surfaces opposite one another; rotation suddenly produced will then cause them to grate upon one another, and to indicate at once that fracture is present. The crepitus may be rendered obscure owing to the capsular ligament not being torn through, but keeping the ends of the bone in close contact, and preventing the shaft of the bone from moving without taking the round head of the femur with it. Under these circum-

stances, if rotation suddenly made upon the limb will not produce it, extreme flexion of the hip may be tried, by bringing the knee upwards and then extending it again; this motion is often sufficient to unlock the portions of bone, and to cause them to rub upon one another, when no other position will do so.

The crepitus can generally be discovered by producing one of the above motions in the limb, but there are some cases in which it cannot; for the ends of the bone appear to be so locked together, that no new position into which the bone can be brought has the power of unlocking them from their close contact. When this is the case, however, the nature of the injury can still be ascertained by paying attention to the points already mentioned, namely, the shortening of the limb and the eversion of the foot; for when these exist, there is only one thing for which they might be mistaken, which is dislocation of the head of the bone upwards, either on to the pubes or the dorsum of the ilium, and it can be distinguished from the former injury by there not being the round head of the bone felt in the situation it would be if there were dislocation; and it can be distinguished from the latter, by the foot being turned outwards instead of inwards, and by the head of the bone not being felt on the dorsum of the ilium. Fracture of the neck of the thigh bone can never be mistaken for dislocation into the thyroid foramen, for the limb is always shorter instead of longer, which it would not be were there dislocation in this direction.

The pain that accompanies fractures of the neck of the femur is often very severe; the patient not being able to bear pressure on the anterior part of the joint, in the situation of the insertion of the flexor muscles; and it will generally be found to be greater in this situation

than in the posterior part of the hip, dependant no doubt on the anterior part of the joint being more strained upon, and to the large anterior crural nerve partaking of the injury to a certain extent, and being included in the inflammation that arises afterwards. This symptom cannot be depended upon by itself, as a diagnostic mark of the existence of fracture, for it often exists after a simple bruise, and remains a long time, and is produced on the least attempt of the patient to move the joint, at the same time that he is unable to bear any weight upon the limb, owing to the pain being increased.

It is not uncommon to meet with cases where the limb is shorter than natural, and the knee turned inwards, so as to give the appearance of dislocation being present or of the neck of the bone being fractured, and accompanied with the state of inversion of the foot instead of eversion, when neither of these circumstances may be present; but there may be simply a bruise on some part of the hip that causes the patient to turn the limb inwards, to give himself ease, and to flex it to take off tension from the anterior part of the joint. This point should be borne in mind in examining these cases, where any obscurity exists in the nature of the injury. Inability to move the thigh, is also a symptom that is met with in fractures of the neck of the bone; but it may also exist with a simple bruise, and must not be taken by itself. Another symptom is (as might be expected), total inability to bear any weight upon the fractured limb; this is not, however, invariably the case; for instances are on record where patients have walked some distance after the injury. It is a symptom which may also exist from a simple bruise, owing to the pain which the patient experiences

when the muscles are exerted which are necessary to keep the body erect.

The above then are the symptoms of fracture of the neck of the thigh bone, which vary as to the number of them that may be present, and as to the degree in which they exist, so as to make them diagnostic of the nature of the injury ; for in some cases it is found that the closest and most careful examination is required to discover the existence of the fracture, whilst in others the symptoms are so decided that the presence of it is detected at once, by only making a very superficial examination of the limb. It is of the utmost importance to ascertain the precise nature of the injury, for the patient may otherwise be confined to his bed for an unnecessary length of time, under the supposition that fracture exists when really it does not ; or, on the other hand, he may be told that his injury is merely a bruise, and that he will soon recover the use of his limb again, when the fact may turn out to be that the neck of the bone has been broken, and that the patient may be lame for the rest of his life. Either of these erroneous opinions being formed will bring discredit on the surgeon, and more particularly the latter one, which should make him very careful in his examination, and very cautious in the opinion he may give as to the result of the case, if there be any obscurity about the nature of the injury.

TREATMENT OF FRACTURES OF THE UPPER END OF THE FEMUR.

The difference that exists between fractures of the shaft of the bone and those that take place through the trochantral portion or neck of the bone is so great, that quite an opposite principle in the treatment of the two

kinds of injury becomes necessary. This difference is found to depend upon the influence the muscles exert upon the portions of bone being different in the two cases; for that class of muscles, namely, the flexors of the hip, which are inserted into the trochanter minor, and which influence the position of the upper portion of bone, where fracture takes place in the shaft of the femur, will have no influence upon the upper portion in fractures above the trochanter minor, but will act upon the lower portion instead, as it is to this lower portion that they are now attached; so that there will be no tilting upwards of the upper portion of bone, which rendered the treatment by position on the inclined plane so peculiarly applicable, by relaxing all those muscles that tended to do so, at the same time that it allowed of the lower portion of the bone being brought on a level with the upper, without the necessity of using any mechanical violence. This principle I explained at length, when treating of fractures of the shaft of the bone, so that it is unnecessary to state it again here. But when the trochantral portion or the neck of the femur is the seat of the fracture, the treatment by position on the inclined plane will act upon the lower portion of bone and bring it into a line that there is no reason to suppose the upper portion of bone to be in, for there are now no muscles left attached to this upper portion that can produce flexion of the hip joint; or, in other words, that can tilt the upper portion of bone upwards, as there are when the fracture is below the trochanter minor. It will be evident at once, then, that there must be many cases, if not the majority, in which the upper portion will remain stationary in the acetabulum, while the shaft of the bone is carried forwards in a line of flexion when

the inclined plane is used; for without the two portions be locked within one another, the upper will of course remain stationary while the lower one is moved, and if allowed to unite in this position, will be sure to produce deformity, as the line of apposition of the two portions of bone will not correspond. When the fracture occurs above the lesser trochanter, the degree of retraction is also greater; for the powerful glutæi muscles will now act upon the lower portion of bone, (for they are now either one or all of them connected to it, according to the situation of the fracture being through the trochantral portion or completely through the neck of the bone) and will draw it upwards, and often be sufficient to produce shortening in the limb to the extent of two inches or more.

Now this kind of shortening is quite different to that produced by fracture through the shaft of the bone, below the trochanter minor, for then the muscles that produce the retraction, are most of them relaxed by the position on the inclined plane, which, as before stated, renders this plan of treatment so peculiarly applicable to that kind of fracture; but in fractures through the neck of the femur, there is an additional class of muscles attached to the lower portion of bone, namely, the glutæi, which muscles are not relaxed by the position of flexion, and consequently will not have any disposition to yield when the inclined plane is used, nor admit of the reduction and proper adaptation of the fractured surfaces to one another. Another difficulty then which the inclined plane cannot overcome, is this retraction of the lower portion above the upper; for as I stated when speaking of fractures of the shaft of the bone, that the advantage gained by the inclined plane was, that no mechanical violence

need be employed, any more than the weight of the limb itself produces, by the leg being placed at a different angle to the thigh; but it is found that in fractures of the neck or trochantral portion, it is often requisite to apply great force in many cases before the fractured limb can be brought to the same length with the sound one, which force is required to be much greater than the mere weight of the limb can produce by being placed on the inclined plane.

There are two reasons then, why the inclined plane is not applicable to the fractures above the trochanter minor, though it is peculiarly so for fractures below this part of the bone. The one is, that the upper portion of bone is not in a state of flexion, so that the lower portion would be brought into a different line of apposition by being placed on the inclined plane; the other is, that a degree of retraction exists, which is caused by a class of muscles, whose action simple position only is not sufficient to overcome, and which are but very slightly relaxed when the inclined plane is used.

In fractures through the neck of the femur, it will be obvious, even allowing the inclined plane to be capable of keeping up sufficient extension for a short time, that after a while the least sinking of the pillow or mattress on which the patient lies will approximate the knee towards the pelvis, and consequently at the same time drive the shaft of the bone upwards, and push the fractured surfaces past one another. Again if this shortening do not take place, one of the fixed points gained by the inclined plane is at the tuberosity of the ischium, which must at the same time press upwards towards the neck of the bone, and so tend to drive the lower end of the shaft upwards or towards

the outer part of the pelvis, by pressing the mass of flesh on which the bone lies upwards against its moveable extremity; for this upper end is easily moved now, by the length of the shaft giving a force, when applied to it, a lever power.

Another objection to the inclined plane in fractures of the neck of the bone or obliquely through the trochanter is, that no lateral pressure can be made, at least with any degree of force sufficient to steady the fractured surfaces one against the other, which is a most essential part in the treatment of fractures in this situation; for it will be seen that the two ends of the bone are not placed transversely, or obliquely, so as to allow of a slight force keeping them in contact; but the two surfaces are placed laterally with regard to one another, and with a disposition to be separated; so that at the same time that extension is requisite to bring them opposite one another, pressure on the outer side of the limb is necessary to keep them in contact or against one another. Now this pressure cannot be gained by the inclined plane, for this position will only allow of the application of a short splint to the outer side of the limb, which cannot have sufficient purchase to enable the requisite degree of pressure to be made upon the ends of the bone.

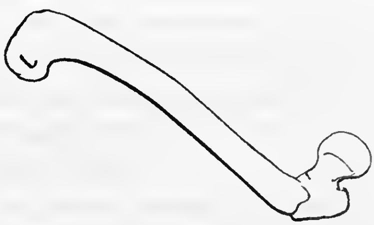
It may happen in some cases when the inclined plane is used, that the upper end is pushed behind as well as above the neck of the bone, owing to the angle of the plane being too great, which will raise the knee at too high a level, and so tend to push the trochantral portion downwards as well as backwards. I have seen this deformity produced, and it can always be ascertained by measurement taken from the anterior superior spinous process of the ilium, to the top of the great

trochanter, and at the same time observing the vertical distance from the crest of the ilium to the same point.

Any deviation in the length of the inclined plane will be sufficient to cause displacement of the fractured surfaces, when the neck of the bone is fractured: for if the board on which the thigh rests be too short, the weight of the limb will push the trochantral end upwards towards the pelvis, and above the neck of the bone; and if it be too long, the same evil will be produced, for either the knee must be dragged over the angle of the plane, or else the tuberosity of the ischium must press upon the end of the plane, and not below it as it should do: in either of which cases, the little extension which the inclined plane is capable of keeping up, will be lost, and then the knee and pelvis must become approximated, and the apposition of the fractured surfaces be consequently destroyed.

The limb may be of the same length when the inclined plane is used, and still the two fractured surfaces need not be in proper apposition: for, as I have already stated, the upper portion of bone may remain stationary in the acetabulum, and not follow the lower one when it is bent upon the pelvis—and the evil that this deformity will produce must be evident, namely, that the after-extension of the limb will be prevented; for the upper portion of bone upon which the extension depends, is already nearly, if not quite, extended; while the lower portion of bone is in a state of flexion, owing to the position it has been in on the inclined plane; so that the knee cannot be brought straight beneath the pelvis, when the patient stands erect; the consequence of which is, that he is obliged to bend the pelvis forwards to allow of the foot being placed flat

on the ground, which produces a stoop in the patient's body, as he cannot keep the leg straight at the same time that he keeps his body erect. It is not uncommon to see this deformity after fractures of the thigh bone above the trochanter minor. I have given a drawing of the position of the two portions of bone, from which it will be easily understood how the above deformity I have mentioned can be produced, where union is allowed to take place with the ends of the bone in such different lines of apposition.



If the above objections that I have made to the treatment of fractures of the neck of the thigh bone, by flexion of the hip be good, I am of opinion that the inclined plane, or that Earle's and Amesbury's beds, which are but modifications of the inclined plane, are not the best means that might be adopted, and that deformity must in many cases exist after their employment. The grand object said to be gained by Messrs. Earle's and Amesbury's beds is, that the pelvis and head of the femur are more steadied, and that the trochantral extremity of the bone admits of being firmly pressed against the pelvic portion of bone, and so kept close in contact with it, and the union thereby facilitated, if not altogether promoted by this means: for these authors say, that non-union of fractures of the neck of the femur is chiefly dependant on the want of proper means to steady the two portions of bone,

and to keep them pressed against one another. These opinions, however, I shall discuss presently. One of the authors (Mr. Amesbury) admits the liability for the shaft of the bone to fall below the pelvic portion in the employment of his own bed; for he says, " A thin pad should be placed between the upper part of the back of the thigh and the mattress, to *raise* and support the trochanter major."* It will be difficult to get a pad, of the exact thickness, to ensure the surfaces being on precisely the same level; and the pad may become displaced, and sink by the pressure of the limb, and so allow of the shaft of the bone falling below the upper or pelvic portion.

In fractures of the shaft of the bone below the trochanter minor, I believe these beds to be of decided advantage, and Mr. Amesbury's more particularly, as the sliding thigh-board admits of the exact length of the limb being obtained; for in this kind of fracture, the mass of muscle placed between the bone and the mattress, supports the fractured ends on the same level, as the pressure then tells upon them both. In fractures of the neck of the femur, however, the shaft of the bone below the pelvis is still supported, but then the portion above this level is not, for the prominence of the tuberosity of the ischium prevents the support being given to this part of the bone, and hence the necessity for the pad which Mr. Amesbury recommends, in order to raise this extremity of the femur which naturally falls down, for the above reason. The other objections I have made, namely, the different degree of flexion of the two portions of bone, and the difficulty of preventing retraction completely, will stand equally good with regard to the employment of

* Page 220, Vol. I.

these beds, as with the simple inclined plane. I do not consider that there is any better means of making the lateral pressure, to keep the two portions of bone firmly against one another, by the employment of Amesbury's or Earle's bed, more than the simple inclined plane possesses; for it is done by the same means, namely, a splint passed from the knee up to the side of the pelvis, and fastened by a strap round the whole pelvis itself. This kind of splint is, as I before stated, too short, and has too little purchase on the limb below, to allow of any great degree of pressure in the direction in which it is meant to tell.

The above then are my reasons for objecting to the treatment of fractures of the neck of the femur, or of the great trochanter, by the position of flexion of the hip,—either by means of the common inclined plane, or by those beds which have been invented for the purpose,—the position of the limb still being the same. From the above objections I should draw the following conclusions, with regard to the treatment of this kind of fracture, and should advocate a plan quite opposite to the one of which I have just been speaking. In the first place then, I should say that fractures of the neck of the femur require extension in the majority of cases; for retraction is one of the most prominent symptoms, and exists often to a great extent, and is difficult to overcome; and the extension required is greater than can be produced by the inclined plane, so that some more powerful means become necessary. Secondly, in fracture of the neck of the bone, the straight position of the limb is more likely to ensure the two portions of bone being in the same line than when the hip is flexed; for the latter position implies that the pelvic portion follows the shaft of the femur, when it is placed

in the position of flexion, which I believe, in the majority of cases, it does not do, though it may in some, from the peculiar direction the fracture may have taken causing the two portions to be locked within one ananother. Thirdly, the straight position allows of lateral pressure being more forcibly and directly made; for a splint can be applied the whole length of the limb, from the foot upwards, to some distance above the pelvis; so that more purchase can be got than when a small splint is applied from the knee to the pelvis only, which is all that can be done when the limb is placed in a state of flexion on the inclined plane. But when the splint is applied in a state of extension, the lower extremity and the pelvis become joined together as one bone, and the two portions of bone are completely fixed and steadied, at the same time that the fractured surfaces are firmly pressed against one another.

The means that obtain the above ends then, I should say were the best for the treatment of those fractures occurring above the lesser trochanter, and are consequently those from which most advantage will be derived, and by which less deformity will be produced in the limb after union has taken place; and this is done by the employment of the long splint, the application and principle of which I fully described at page 291, and so need not dwell further upon them here. It certainly obtains all the above ends, both by keeping up sufficient extension and pressure upon the fractured surfaces, as immense purchase can be got laterally, from the length of the splint and the width of it, which should be from four to five inches at the upper part, where it presses upon the great trochanter.

The grand objection to the employment of the long

splint, where the central part of the shaft of the bone is fractured, is here absent, namely, the action of the flexor muscles of the hip; for now, that the injury is situated above the trochanter minor, they will take effect upon the lower portion of bone instead, since their insertion is connected with it, and has no connection at all with the upper portion: the consequence of which is, that they tend to pull the shaft of the bone upwards towards the pelvis, and at the same time forwards towards the spinous process of the ilium. They have not however much power to pull it forwards; for there is the powerful glutæus maximus muscle, which is inserted into its posterior part, and which will tend to pull the bone in this direction, and so counteract the flexor muscles: but these two sets of muscles, acting together, will tend to pull the shaft of the bone upwards, and so cause the trochanter to be at a higher level than natural, the bone itself being kept midway between flexion and extension. Now this position is very advantageous for the employment of the long splint; for when the foot and leg are drawn downwards, by applying force in the line C, in the woodcut, the upper end of the shaft will be kept at its proper level, owing to the flexor muscles pulling in the line A, and the glutæus maximus in the line B; so that the fractured surfaces will be brought opposite to one another, and can be kept in close contact by making lateral pressure against the bone.

One objection to the employment of the long splint in fractures of the upper part of the thigh bone is, that

the bandage that presses against the groin and under the perineum, has a tendency to press outwards at the same time, and so to push the fractured surfaces from their contact: this is an evil that may exist where the splint is made too short; but it can always be obviated by making it long enough to extend some way above the pelvis; for then the pressure will tell more perpendicularly, and have little or no effect upon the limb laterally. This pressure of the shaft of the bone outwards will also be further guarded against by bracing the upper part of the splint to the pelvis, by a bandage or strap carried round it to the opposite side.

PROGNOSIS OF FRACTURE OF THE NECK OF THE FEMUR.

The prognosis of fracture of the neck of the thigh bone is by most surgeons considered unfavourable: for in the majority of cases, if not in all, there remains lameness of some kind afterwards; often rendering it necessary for the patient to walk with a crutch for the rest of his life; or, if he recover sufficient strength in the joint to walk without one, some degree of lameness still remains, which may be enough to deprive the limb of its natural free motion which it possessed before the accident.

The unfavourable termination of these cases is found to depend on two causes—one is the difficulty of producing ossific union where the fracture is confined to the neck of the bone—the other, is the difficulty of overcoming the great degree of retraction that takes place where the fracture extends through the trochanter, external to the capsular ligament; so that although the union in some of these cases is strong and

ossific, the patient is still lame, owing to the shortening of the limb produced by the peculiar direction of the fracture locking the portions of bone within one another, or by the great retraction that originally took place not having been overcome: either of these causes will be sufficient to deprive the limb of its natural strength and freedom of motion.

Fractures of the neck of the femur, within the capsule, are so rarely found to unite with anything approaching bony union, that it is still a question whether it ever is produced in those cases where the fracture is quite internal to the capsule, and the ligament itself uninjured. Many of the highest authorities are still at variance with regard to this point: some asserting that bony union is quite possible, and does sometimes take place; while others assert the contrary, and say that it never is produced where the fracture is confined to the situation above mentioned. It is my intention to give the various opinions that have been advanced both for and against the question; and to consider the arguments that are brought forward to support the different views of the subject, and then to draw conclusions from them as to which appears the most probable.

Sir Astley Cooper says, "Much difference of opinion has existed upon the subject of the union of the fractured neck of the thigh bone: it has been asserted that these fractures unite like those of other parts of the body; but the dissections which I made in early life, and the opportunities I have since had of confirming my observations, have convinced me that fractures of the neck of the thigh bone—those of the patella, olecranon, and condyles of the os humeri—and that of the coronoid process of the ulna, generally

unite by ligament, and not by bone." Again he says, "In all the examinations which I have made of transverse fractures of the cervix femoris, entirely within the capsular ligament, I have never met with one in which a bony union had taken place, or which did not admit of motion of one bone upon the other."*

The only true mode of ascertaining the cause of this difficulty, or impossibility, of producing bony union, is by well considering the anatomical structure of this part of the bone, and the relation of the soft parts around it; and then to compare the circumstances under which the fracture is placed when situated in the neck of the bone, with those of fracture occurring in the shaft, or in any part of the bone external to the joint. It has already been stated that fractures of the neck of the femur may occur, either completely within the capsule (this membrane not being at all injured), or else that the capsule may be lacerated, to a greater or less extent, the fracture still remaining confined to the cervix of the bone, or extending outwards, so as to include the trochantral portion. It is upon this distinction, with regard to the capsule being injured or not, that the true explanation of the kind of union that takes place, is to be sought for, and upon which I mean to found my reasons for supposing that in the one case bony union can never be produced; while in the other it may be, and often is. I shall first consider the different cicumstances under which the bone is placed, in relation to the adjacent soft parts, when the fracture is within the capsule, and when it is external to it: I shall then consider the process of union that takes place in common fractures, or those unconnected with joints; and see how far the same process can be pro-

* On Fractures and Dislocations, p. 110, 111.

duced in fractures of the neck of the femur—and the want of analogy between the two, I think will be quite apparent, and fully shew that if we are to expect all fractures to unite by one general law, that same law cannot work in two such opposite cases as those of a fracture completely within the capsule of the hip joint, and one extending external to it: for if bone is to be expected in the one kind, it cannot be in the other.

The shaft of the femur is surrounded by a dense, strong periosteum, which membrane is highly susceptible of vascular action. The shaft of the bone itself is also very vascular, both in its own compact structure, as well as in its medullary substance and membrane. The large mass of muscle also which surrounds the bone, adheres closely to the periosteum, and takes on action on the slightest injury being done to it; so that the shaft of the bone may be said to be surrounded with blood vessels, both from its own membrane, and from the muscles that lie in contact with it.

Now what analogy do the neck and head of the bone bear to the shaft in this respect? none at all, for the circumstances are quite different when fracture exists, for the main source from which these parts receive their blood is cut off owing to the neck of the bone being broken, so that the blood is no longer brought from the shaft and trochantral portion upwards, for the vessels that do so in the sound state of the bone are divided by the fracture. But there is another great difference between the neck of the bone and the shaft, namely, the absence of the insertion of muscles into it, so that their vascularity has no effect upon this part of the bone like it has on the other parts that are thickly clothed with muscle, for the neck of the bone

is completely isolated by the capsular ligament surrounding it in the manner it does. It is of great importance to bear this distinction in mind, as upon it depends the true explanation of the cause of non-union by bone, and which I am inclined to think those who advocate the possibility of bony union being produced, overlook or else do not attach sufficient importance to it.

Those who advocate the possibility of bony union taking place, have many reasons to advance why it does not do so in all, and why it is slower in forming when it is produced, than in fractures external to joints. It appears to me, however, that they do not decide sufficiently between those cases where the fracture is completely within the capsule, the ligament being uninjured, and those cases where the ligament is lacerated, and where the fracture extends external to it; for of course when there is a communication between the ligament and the soft parts externally, the fracture becomes almost similar to one situated in the shaft of the bone, for the soft parts around can then influence the union in the same manner that they do when the fracture is in the shaft. The objections, however, which I am now making to the non-union by bone, apply solely to those fractures which are confined entirely within the capsule, and when the capsule is free from laceration.

The advocates for ossific union state that there is nothing peculiar about this kind of fracture that should prevent it uniting by bone, but that the reason of it so seldom doing so, is owing to the imperfect mode of treating the injury, and not to any want of power in the action of the part itself. "I am well aware that, under ordinary treatment, the fractured ends are not kept in a state of quietude, and that the degree of

motion which is allowed to take place in these fractures, is often sufficient to prevent union in fractures much more favorably situated. It will, however, be perceived, that this impediment to union is referable to the imperfection of the mechanical means resorted to, rather than to the nature of the injury, for the cure of which they are employed. From the view which I take of this subject, the cause of want of union which is observed in these cases is not physical, but mechanical. The fault lies at the door of surgery, and not in the nature of the accident."*

Another author says, "And here I may state my firm conviction, that it is in the great mobility of the upper portion of the bone, which partakes of the slightest movements of the trunk and pelvis, that all the difficulty in the proper treatment of these cases depends; and the little attention which has hitherto been paid to restrain this free motion, is the great if not the sole cause of non-union or union by ligament. The defect has been in the mode of treatment, not in the powers of nature; and surgeons have arraigned her laws for their own neglect and inattention."†

Another very high authority also gives the same reason for the absence of bony union. "The true cause which hinders, or at least which renders difficult the exact and firm consolidation, and above all the consolidation without deformity, is the displacement of the fragments, the want of apposition and of contact that exists in fracture external, or even internal to the capsular ligament."‡

From the above quotations it will be seen, that the

* Amesbury on Fractures, vol. I, p. 101.

† Earle's Observations in Surgery.

‡ Dupuytren Leçons Orales, vol. II, p. 121.

most important reason given for the non-union of this kind of fracture, is the want of means in the treatment that has generally been employed to keep the two portions of bone firmly and steadily in contact, so that motion may be prevented and the constant apposition preserved. I shall now consider how much this cause does actually prevent the bony union, and see whether it deserves to be brought forward so strongly as an objection sufficient to explain the want of ossific union that is generally met with in this kind of fracture. I think I shall be able to show that it does not, and that there are other reasons, more satisfactory, derived both from the appearance the part presents, when opportunities occur to allow of after-examination, as well as reasoning from the want of analogy that exists between fractures within joints and those that are completely external to them.

No doubt that in fractures through the neck of the bone, there is a great disposition for the two portions to move upon one another, and that from the peculiar position and small size of the upper or pelvic portion, it is difficult to keep them at rest. But although this is a difficulty and an evil when it exists, it nevertheless is not such a one that it cannot be overcome, nor is it an evil that is sufficient to prevent the bony union taking place; both of which assertions I shall be able to prove.

In the first place, then, I say that the ordinary treatment hitherto employed, long before Messrs. Amesbury's and Earle's beds were invented, and the appearance of the many preparations that exist of this kind of fracture, sufficiently prove that this evil has been overcome, and therefore that it could not have been a cause to prevent the bony union taking place

in the cases that I refer to. I say that experience and the specimens preserved contradict the assertion of these authors; for the fact is, that in the majority of cases, ligamentous union is produced although the bony is not; and in many of these cases the ligamentous bands are so fine and delicate, as not to have been capable of resisting any motion, had it been given to the portions of bone between which they extend. I say this circumstance of these ligamentous bands being so frequently found, tends strongly to shew that it is not the want of rest that prevents the bony union taking place, but that some other cause must be looked for. There is a preparation, which was formerly in Mr. Mayo's collection, and now in King's College Museum, (and many similar to it may be seen in other museums), clearly shewing that want of rest could not have existed during the treatment, for the ends of the bone are in correct apposition, and the ligamentous fibres are delicately formed, taking each fibre separately, but sufficient in the mass to form a strong union between the two portions of bone. There are many points of interest in this preparation, which Sir Astley Cooper also quotes in his Work on Fractures, and upon which he has the following remarks:—"The person lived nine months after the accident; and although the age was favorable and the bones were nearly in apposition, ligamentous union only was produced." He also says, "It is curious to observe how little the head of the bone is changed in this fracture, after nine months. Any other bones in the body but those forming parts of articulations would be loaded with ossific matter."

I think this preparation alone would be sufficient (even were there no others), to prove that there must be something peculiar existing in the process of union

which takes place in those fractures that occur completely within the capsule, the membrane remaining entire; for in the above case the apposition of the ends of the bone was good, and the ligamentous bands that were formed indicate that there could not have been motion between them. Another circumstance highly favorable in the above case for the production of bony union, was, that the patient was only between thirty and forty years of age; so that want of action in the constitution generally could not be brought forward as a cause for it not taking place. The remarks that Sir Astley Cooper makes about there being no deposition of ossific matter about the ends of the bone, I consider of great importance, for it alone shews that some peculiar circumstance must exist to prevent this part of the process taking place, even if the actual union of the surfaces of the bone could not be produced—for what would take place elsewhere, if a fracture were prevented uniting, owing to the want of proper means being taken to keep the two portions of bone at rest? Why this—a large deposition of bony matter would be formed round the ends of the bone, though there might be none between the fractured surfaces, evidently shewing that an attempt had been made to unite them, but that other circumstances had prevented the process being completed. Now in fractures totally within the capsule, you never find even the attempt at ossific union, for this deposition around the ends of the bone is never found, or even the least appearance of it. The argument of want of vascularity in the bone itself, may be brought in favor of the absence of this deposition in the upper portion, by those who wish to make this a reason; but then it cannot be with regard to the lower or trochantral portion of bone, for it receives its

blood as usual from the general supply, through the shaft and surrounding vessels which pass into it; so that we should expect to find the deposit round this part, if we did not round the upper or pelvic portion.

Not only then does the preparation alluded to above, invalidate the reasoning of those who advocate the possibility of ossific union, and who state that the absence of it is owing to want of rest and proper apposition between the fractured surfaces; but it also shews that there must be something peculiar in the condition of the parts, which totally prevents that action taking place round the ends of the bone which is so essential for the production of bony union elsewhere, namely, the ossific deposition which is found as a preliminary step to the direct union between the ends of the bone themselves, known as the provisional callus. Now this I say never takes place in fractures completely within the capsule, where there is no laceration of the capsule itself.

It is stated by some, that if the vessels have the power of throwing out these ligamentous bands, why should they not have the power of depositing the ossific matter as well? I should say to this, that such reasoning is fallacious and not borne out by analogy, for it is presuming that the action that takes place is similar in the two instances, namely, that ligament is formed by the same process that bone is. Again, it is presuming that the parts are under precisely the same circumstances that fractures external to a joint are, which I have shewn is not the case when speaking of the relation the soft parts bear to the neck of the bone, and to the shaft lower down.

Again, reasoning from analogy with regard to the ligamentous union that takes place, and against its

being dependant only on the want of proper apposition between the ends of bone; what do we see in fractures elsewhere, when motion is allowed to take place? Why, not that ligamentous union takes place, but that no union at all is produced and a false joint remains; which false joint consists in the ends of the bone becoming thickened by ossific deposits, and by being surrounded by a capsule, while the opposed surfaces of the bone are smoothed and rounded, and move one upon the other without the intervention of any ligamentous bands at all; so that we should expect the same to be produced in the neck of the bone, were it only depending on the same cause; but we find just the opposite to be the case, for instead of there being a thickening round the bone, there is none; but there are ligamentous fibres occupying the whole surface between the ends of the bone, instead, while there is a total absence of them in the former instance. The circumstances of the two cases then are quite different.

In making the above remarks against the opinion that the non-union by bone, is dependant on the want of proper means to preserve the fractured ends in close contact, it is not my intention to deny the influence it may have, when allowed to exist to any great extent, for then of course motion of the two surfaces will have the same influence upon the process of union in this kind of fracture, that it has on fractures occurring in other parts. All I mean to say is, that in the majority of instances there is sufficient evidence to show, that the ends of the bone have been kept at rest and in close contact, and that still no attempt at the union by bone has been found; and that the true reason of its not taking place, is to be looked for in the isolated

position of the two ends of the bone, which are so placed when the fracture is unattended with laceration of the capsule, that they are quite removed from the influence of the action of the soft parts around, which is known from analogy to be so essential for the production of bony union in fractures that are situated external to joints.

I think that those authors who advocate the possibility of bony union in fractures of the neck of the thigh bone, exaggerate the degree of motion that takes place: for, allowing that either the common inclined plane is used or the long splint—and that they do not bring the ends of the bone in direct contact—there is still but very slight motion produced between them after the apparatus is once applied; for the patients are generally old people, and have little or no disposition to move from the position they are placed in by the surgeon: exceptions there are, of course, where the patient is restless, and will not keep the limb quiet; but this is certainly not the general rule. The greatest degree of motion is likely to be produced when the bed-pan is placed beneath the patient; for then the pelvis will have to be raised, and the apposition of the ends of the bone may be disturbed: but I should say then that the disturbance is very slight, and is so seldom required, that it is not an evil sufficient to prevent bony union, were it otherwise inclined to take place. Besides, when the long splint is employed, the displacement will be little or none; for the pelvis will not move without taking the shaft of the bone with it. Other kinds of fracture are often moved to a much greater extent than those of the neck of the bone are, and still the ossific process goes on, and the ends of the bone become firmly united.

The authors that I have quoted—as laying so much stress upon the necessity of keeping the ends of the bone at perfect rest, and firmly pressed against one another, do not all agree as to the means that are to be employed to gain the desired end: for while Messrs. Earle and Amesbury recommend the absolute necessity of employing their beds, if bony union be wished for,—Dupuytren, who, as already stated, advocates the possibility of ossific union as well, merely recommends the limb to be laid across pillows; and what very little means there will be by this treatment to preserve rest, and to prevent displacement, must be evident; and how little necessity there must be for a more complicated apparatus, if union can be produced by this simple means. I shall quote a passage from each of these authors, in illustration of the kind of treatment they object to, and of the one they recommend.

In the first place, Mr. Earle says, with regard to the common inclined plane,—"In removing the fæces, more or less motion must be given to the pelvis; and as the other limb is left at liberty, there will, in all cases, be more or less power of moving the pelvis as the bandages become loosened, and consequently the upper portion of the fracture will be liable to be displaced, which cannot but be unfavorable to bony union."* The above evils Mr. Earle obviated by employing his own bed, which he recommends in the following terms: "It is at once simple and easy of application; it can be endured for an indefinite length of time, which is very essential in treating fractures within the articulation, which require several months for perfect union;—it is fully adequate to maintain the pelvis quiet, and to extend the limb."

* Practical Observations in Surgery, p. 110. 124.

Mr. Amesbury objects to the common inclined plane as follows:—"From what I have said, I think it will appear that the double-inclined plane, or fracture box, is not calculated to answer the indications above detailed. It does not afford a steady support to the trochanter, so as to keep that part of the limb in its natural position; it does not prevent retraction of the limb; it does not keep the fractured surfaces in close apposition; it does not prevent the fractured ends from moving upon each other; it gives the surgeon no command over the fractured ends of the bone; and consequently he who can obtain no better means, ought not to be considered answerable for the results of a single case, because his efforts are resisted by mechanical forces over which he has no controul." With regard to his own bed, Mr. Amesbury says,—"I have succeeded, beyond my warmest expectations, in constructing a fracture bed, which has the advantages of being more simple, more portable, and at the same time more efficacious than any other with which I am acquainted. I do not know any attainable indication in these cases which it does not enable the surgeon to fulfil most effectually."*

I shall now quote a passage or two from another great authority, who objects to the employment of the inclined plane, but not to the position. "The first apparatus which I employed, consisted of two inclined planes of wood, covered with cushions and joined by a hinge, to allow of its angle being varied according to circumstances; but the summit of the two planes applied against the ham, produced pain that became intolerable. In one case the long and constant compression of the parts occasioned gangrene of the upper

* Vol. I. p. 195.

portion of the calf of the leg." The plan Dupuytren recommended was simple, and merely consisted of pillows placed beneath the limb; his apparatus was composed of "a pillow rolled upon itself, round as a bolster, and fixed in this form by tapes, and placed at the top of two inclined planes, also formed by many pillows placed one upon another and joined at one of the edges." Again he says,—"In employing this mode of treatment, you obtain an easy cure, exempt from serious evils during the application of the apparatus, and generally the consolidation is without shortening, or at least the shortening is very little apparent."*

It does not require much consideration to see how the above opinions differ, and yet they are taken from authorities all of whom advocate the possibility of bony union taking place. In the first place, Messrs. Amesbury and Earle dwell upon the importance of perfect rest, and the proper extension and apposition of the ends of the bone; and their beds no doubt are well fitted for the one end, namely, perfect rest, though I believe them to be inferior to the long splint for keeping up extension and pressure against the fractured surfaces. On the other hand, Dupuytren's method has no means to guard against these evils; for no one will allow that pillows only, will have any power of keeping up extension or of preventing motion between the pelvis and the shaft of the bone; and yet this author states that he produced bony union by these means, without the necessity of any other mechanical contrivance.

To this treatment by pillows, one of the above authorities (Mr. Amesbury) objects in the following decided terms:—"I need not say any thing to shew the

Dupuytren, Leçons Orales, vol. IV. p. 217.

inadequacy of the pillows to keep the limb quiet; for as no beneficial effect is expected to arise from surgical treatment, except in the employment of means to subdue the inflammation, no attempt is made to secure the parts from motion, or to answer effectually any other indications that I have observed: but I hold it an axiom in surgery, that if we are satisfied that no good can be obtained, we should be doubly careful that we do no mischief;—an axiom which I cannot help thinking is overlooked when this plan of treatment is pursued."*

Now one thing is certain, from the opinions that I have quoted above, namely, that one or the other must be wrong: for one says that no union by bone can be got, without the greatest care be taken to prevent motion and to guard against the exact apposition of the ends of the bone being disturbed; while the other says that the union takes place as well by merely placing the limb over a few pillows, by which means no great care is taken to guard against motion, or to preserve the fractured surfaces in contact.

From the above discrepancy in the statements I have given, I should be inclined to say, that those cases where the patients have recovered, the fracture has not been confined to the capsule only; and that in many of them where bony union was suspected to have taken place, the absence of opportunities to examine the part afterwards, deprive them of the proof that such was the fact; for certainly two such opposite treatments could not produce bony union, if such absolute and perfect rest, and such close apposition of the ends of the bone are necessary before it can take place, as the above authorities state. I am still

* Page 207.

inclined to believe that the above means have no more power to produce bony union, than either the simple inclined plane or the long splint; and that Sir Astley Cooper is quite justified in saying, "But all the means which I have seen used have been unavailing; I have been baffled at every attempt to cure, and have not yet seen one single example of union in this fracture. I know that some persons still believe in the possibility of this union, by surgical treatment, and that instances of success have been published; but I cannot give credence to such cases, until I see that the authors were aware of the distinctions between fractures within and fractures external to the articulation."

The above difference in the treatment of these authors that I have quoted, I think also proves that some other reason must exist for the want of bony union than mere position and rest alone; for if Messrs. Amesbury's and Earle's beds were absolutely necessary to obtain these ends, how is it that Dupuytren by simply laying the limb upon three or four pillows, produced (according to his statement) the desired effect by getting union, and this generally without shortening. Dupuytren then, who is a strong advocate for bony union, tends at the same time to disprove the necessity of absolute rest and the close apposition of the ends of the bone as being requisite for the production of it, by the simple treatment he recommends.

Mr. Amesbury I think also disproves the necessity of such nice apposition; for in one part of his work where he is wishing to prove that he has met with preparations illustrating bony union, he quotes cases that were sent to him, in two of which he says, "No attempt was made to unite the bone;" and in the other

cases the ordinary treatment was had recourse to, namely, either by employing the long splint or inclined plane; while in another part of his book, that I have already referred to, he makes decided objections to those plans of treatment, and says that it is owing to their adoption that bony union does not take place.

Having entered at some length upon one of the most important reasons adduced by those who advocate the possibility of bony union as a cause of its not generally taking place, I shall now consider some other reasons that are advanced, and more particularly those that the advocates for the non-union by bone adduce as the cause for supposing that it can never take place.

Some authors draw nice distinctions between fractures of the neck of the bone, by dividing them into those in which the synovial membrane is slightly lacerated; and into those where it is almost, or completely, torn through: and they mention the latter case, namely, where the membrane is lacerated to any great extent, as a cause sufficient why bony union does not take place. This opinion I do not think requires much argument to shew how little importance it deserves: for, in the first place, when the displacement exists, it must always be greatly lacerated—and, I should say, completely; for the ends of the bone cannot be separated without this delicate membrane being torn through; and, in the second place, giving so much importance to this synovial covering of the neck of the bone, implies that the process of union is dependant on the periosteum, and that it throws out the ossific matter; whereas it is known that in other fractures the periosteum is the last part to enter into the pro-

cess, and that consequently it ought to be in fractures of the neck of the bone.

Sir Astley Cooper, who is one of the greatest authorities, advocating the non-union by bone, gives some of the reasons that I have already mentioned, namely, the want of apposition and pressure against the fractured surfaces, as causes why it does not take place. This, as I have already stated, may tend to retard it, when allowed to exist to a great extent, but it is not a cause sufficient to prevent it altogether. And I have also shewn, that those who advocate this as an objection, contradict themselves, by quoting those cases where, from the kind of treatment employed, no such pressure or nice apposition could have been got; and in which, nevertheless, they say the bony union has been produced.

Another reason which Sir Astley Cooper gives, has more weight attached to it; but still I cannot say that I think it sufficient to explain the true cause of the peculiarity of the union in these fractures. He says—"But the third and principal reason that may be assigned for the want of union of this fracture, is, the almost entire want of ossific action in the head of the thigh bone when separated from its cervix; its life being supported by the ligamentum teres, which has only a few minute vessels ramifying from it to the head of the bone." The importance of this observation, no doubt, is great; and would be still greater, were it sufficient to be a cause altogether for the non-union taking place; which it would be, did union depend upon the action of the ends of the bones themselves throwing out the ossific matter, without any assistance of the surrounding soft parts; for then we should expect that it would scarcely be formed at all,

from the pelvic portion, which when fractured, only receives its supply of blood from so small a source as the few vessels that pass through the ligamentum teres, and which now is the only source when the neck of the bone is fractured and the periosteal covering torn through.

The arguments that can be brought forward against this want of the usual supply of blood being a cause sufficient to prevent bony union, are, that the fact of ligamentous union being so often found, shews that there is plenty of action in the pelvic portion, as well as the formation of the smooth ivory surface that is often met with after this kind of fracture. I have already stated that these facts, though they tend to shew that there is no want of action in the portions of bone, do not equally tend to shew that bony union might take place; for, as I have before said, that is implying that the process of bony union is the same as the ligamentous; and that any part that can produce ligament, will at the same time have the power of producing bone. It also implies that it is not necessary for the adjacent soft parts to take on any action to assist in the process, which we know to be requisite, by looking at the process by which other parts of the bone are united, when fracture occurs external to the joint.

Sir Astley Cooper lays the most stress upon this want of a sufficient supply of blood to the pelvic portion of bone; which may be seen from the passage I have already quoted from his work. Messrs. Earle, Amesbury, and Dupuytren, all have the same opinion with regard to the influence it will have in retarding the ossific process, though they do not think it sufficient to prevent it altogether. " It is evident, then

(says M. Dupuytren), that the inferior portion receives many more vessels than the superior; the vitality of which is slower and less active: and that, in order to produce consolidation, the inferior portion, which possesses the free use of its vital properties, has to bear all the labour of this consolidation: but it is nevertheless true, that there are sufficient materials of nutrition both for its life, and for it to take part in the process of union."* Mr. Earle says—"This supply, it must be granted, is small, and particularly in old people, to whom this accident most frequently occurs. To this cause may fairly be referred the length of time required for union; and in some instances, in very old and feeble persons, the quantity may be inadequate to the performance of a function which requires considerable vigour."† Mr. Amesbury says—"What is the evident inference to be drawn from these facts? That, as there is in the pelvic portion a less supply of the pabulum, which is necessary for the production of the uniting medium, the process of union must be retarded; as an edifice takes a longer period in building, when the labourers are few, or the materials supplied but slowly: but we must not consider from this, that a fracture thus situated can never unite, any more than we may infer, that an edifice so circumstanced could never be built."‡ The above metaphor is a happy one to illustrate the view Mr. Amesbury takes of the cause of non-union in these cases; but I think it is equally happy if carried a little further, for the one that I have advanced of the non-union, when the fracture is completely within the capsule, and un-

* Leçons Orales, tome II.

† Practical Observations in Surgery, p. 62.

‡ Amesbury on Fractures, vol. I. p. 28.

attended with laceration. For I would say, "If the workmen have no scaffolding to build upon, what is the use of their having the materials?—for how are they to go on with their work?" The provisional callus may represent the scaffolding which we know from analogy to be the part first formed; but now that the capsule is not torn, no such process can be commenced; for the surrounding soft parts have no influence at all upon the fractured ends, and consequently cannot assist in forming that scaffolding on which the remainder of the operation has to be performed before the union can be effected. Without, then, the blood vessels within the joint can be assisted by those external to it, any power of furnishing material that they may possess will be of very little avail.

It is stated by some, that the bony depositions which are found on the surfaces of the pelvic portion, tend to show that the vessels have the power of throwing out ossific matter; and if so, why should they not under favorable circumstances be able to produce the union of the fractured ends? I would object to this argument for two reasons; the first is, that these deposits are most frequently found on the articular face of the bone, and not on the surface of the fractured ends; the second is, that they often exist where no fracture at all is present, which proves that they are no indication of any attempt at bony union; and I believe that in those cases where they are found, when fracture does exist, they have been there before the fracture took place, while the head of the bone was continuous with the shaft; and consequently that they cannot be taken as a proof of the power of the isolated head of the bone to secrete them, without it can be ascertained that they did not exist before the frac-

ture. Again, even where these deposits are on the fractured surfaces themselves, to say that they are the attempt at bony union, is presuming that bone is first formed between the fractured ends, and not in the surrounding textures, which analogy tells us is the case elsewhere. The same objection may be made to the formation of the ligamentous bands being a proof of the power of this kind of fracture to unite by bone; for, as already stated, it is presuming that the union begins between the ends of the bone, instead of in the surrounding textures, at the same time that it also presumes that ligament is formed by the same process that the callus of a fractured bone is.

The increased secretion of synovia within the joint, is by some advanced as a reason for the union not taking place, but this is unworthy of much consideration as an important objection, for other fractures into joints often unite when there is a larger quantity of this fluid effused round the ends of the bone, which becomes absorbed and does not appear to have any power of interfering with the process.

I now come to consider what appears to me to be the true explanation of this non-union being so frequently met with in fractures of the neck of the femur; it is one that seems so reasonable and plain, that I cannot but express my surprise that none of the above high authorities that I have quoted, have brought it forward in order to solve the difficulty that exists with regard to this question. My surprise is still greater, when I find that two of the authors* have given a full description of the process of union of bone generally in their works, but have not carried the reasoning that might be deduced from it, to those fractures that occur

* Messrs. Amesbury and Dupuytren.

in the neck of the femur, where the want of analogy must be seen at once, that exists between a fracture internal to a joint and one that extends externally to it.

The explanation I have to offer is by no means a new one, though it appears to have escaped the above authors that I have quoted.* The whole *principle* of the union of fractures generally, and of the non-union of fractures of the neck of the thigh bone, will be found distinctly laid down in John Bell's Principles of Surgery. He says,—"when the tibia and fibula, the radius and ulna, or any other well-supported bone is broken across, the surrounding parts, muscular as well as cellular, are lacerated; and by the inflammation of the cellular and muscular substance, in concert with the periosteum, that mass is formed, which, by the activity of its vessels, works the blood towards the immediate fracture; and though we cannot say that any organization but that of bone itself, is capable of regenerating bone, yet we plainly perceive the necessity of this thickening of the surrounding parts, which is like a temporary gland instituted for the purpose of secreting bone." * * * * "The neck of the thigh bone, which is completely insulated in its natural condition, can form, when broken, none of those connections with the surrounding parts, which should help to make up a mass capable of retaining the bones in close contact, and of assisting in the generation of callus. This is the reason why all our ingenuity is exhausted in vain, why each successive generation has condemned the inventions of the preceding age."†

* I see that Mr. Mayo in his Outlines of Pathology has taken up this view of the subject, and is the only recent author that I am aware of who has done so.

† Page 85-88, 8vo. edition.

In order to produce bony union in fractures external to joints, it is found by experiments that have been made of late years, and from observations on the human subject, that it is necessary for the soft parts round the ends of the bone to take a most active part in the process; in fact they perform the sole part during the first stage of it, while the fractured surfaces are merely lying in apposition, without any actual union between them. This action and change that takes place in the surrounding parts, has been described when speaking of the union of fractures, as the provisional callus; being essential for the formation of the capsule, which steadies the ends of the bone before they are actually united. Now we have only to consider the circumstances under which the neck of the thigh bone is placed when fractured, and when the capsular ligament is not torn, and it will be seen at once how different they are; for now the fractured ends are completely isolated, and any change of action that may take place in the soft parts externally, can have no effect upon the ends of the bone themselves; besides there is no bruising now of the cellular and muscular substance, as there is in fractures of the shaft of the bone, so that there is no disposition for the provisional callus to form, even were it possible for it to get at the ends of the bone. If then this first and most important part of the process cannot be performed, it is quite impossible that the ends of the bone themselves should unite, as the latter part is altogether dependant on the former. This, in my opinion, explains at once in a clear and simple way (without the necessity of having recourse to the want of apposition or rest, or to the little vascularity in the upper portion of bone), why it is that union by bone never takes place when the fracture is quite

within the capsule, and the capsule itself not torn. I say never takes place, because I believe that the cases related in opposition to this assertion are not sufficiently unobjectionable to form a decided opinion upon; for, in the words of Sir Astley Cooper, already quoted, "I cannot give credence to such cases, until I see that the authors were aware of the distinctions between fractures within and fractures external to the articulation."

I have already stated that the opinion I have advocated, with regard to the impossibility of bony union being produced, when the fracture is in the neck of the bone, refers only to those cases where *it is completely within the ligament, and the ligament itself not torn.* It appears to me that the authors who advance evidence in opposition to this opinion, do not bring forward cases in which it could always be proved without doubt, that the fracture was of the above description, and that it did not extend externally, or that the capsule itself was not lacerated. For this reason I should say that those cases where the patients have recovered the injury, and where opportunities have not been offered of ascertaining the exact position and extent of the fracture, are not proper ones to adduce as proofs of this kind of union occurring; and that therefore they can have no weight in the argument. The only way to get at facts that could decide the question, would be by examining the state of the bone and joint after death (when the history of the case had been known previously), and to see if there be bony union, at the same time that there is no appearance of any injury having been done to the capsule.—I shall now examine this point, and shall consider the preparations that have been advanced in proof of the

possibility of bony union; and I think I shall be able to shew, that there is not one that is altogether unobjectionable, and that can be brought forward without their being reason to suppose that the capsule has been torn in some part or another.

Sir Astley Cooper mentions that he has examined forty-three preparations, contained in different museums and collections; and that out of them all, there was only one that merited a moment's attention; and in this one, there was found to be the same appearances on both sides: and he says, "even these resembled what I have several times observed in the dead body, arising from a softened state of the bones." But what are the other cases that are brought forward in proof of this bony union within the capsule, where opportunities have occurred of examining the part afterwards? They are very few, and these are not without objections.

Mr. Earle mentions cases to prove that sufficient action exists in the pelvic portion of bone to sustain its life, and to render it capable of entering into the ossific process, but he only mentions one where anything like union existed between the ends of the bone, and this is the preparation mentioned by Mr. Stanley, where both bones were alike; and which is quoted by Sir Astley Cooper, who very justly remarks that the same appearances are often found from disease, and that to decide upon this case, the history should be known; for if disease alone will produce the same appearances, there will be quite sufficient reason to object to any preparation that is brought forward, without any proof or reason to suppose that there has been fracture, can be given to explain the points met with, and to show that they are owing to it rather than to disease. The following remarks also explain this point,

"Many bones are preserved and exhibited, in which fracture of the neck of the thigh bone with bony union is supposed to have taken place, but there are strong grounds for suspecting that many such have not sustained actual fracture. The neck of the bone may be shortened, and set on awkwardly, and there may be masses of new osseous deposit round the neck and trochanters. Perhaps the history of a case is known—an old person sustains an injury of the hip, by falling or by a blow on the trochanter; great lameness ensues, and after a confinement of many weeks the patient begins to use the member, which, however, remains considerably shortened. But all this may have taken place, and on examination after death, the parts may have presented that appearance above alluded to without fracture. The change in the bone, is the consequence of diseased action induced by the injury. The blood vessels of the bone and its coverings are excited, and new osseous matter is found at various points, at the same time interstitial absorption of the cancellated texture of the neck gradually advances, and the bone is consequently altered in length and form. These appearances alone therefore do not warrant the confident belief of fracture having occurred, even though the history should seem to prove the assumption."*

The above passage appears to me to explain clearly the cause of the appearances that are met with, and the same may be seen in the thigh bones of old people when no injury has been sustained, but being simply dependant on diseased action and the weight of the pelvis pressing on the bone. In Sir Astley Cooper's work will be found drawings illustrating this point,

* Liston's Elements of Surgery, p. 296.

where it is difficult to say that fracture has not existed from the appearance of the bone resembling it so much.

A preparation is quoted by Mr. Amesbury, belonging to Mr. Langstaff, as decisive of the production of bony union within the capsule; but this to me is far from satisfactory, for I think there are good reasons for supposing that it was attended with laceration of the capsule, and to a great extent. If there be sufficient reason for supposing such to have been the case, it cannot go as evidence in favor of union within the capsule unattended with laceration, which is the point I am now arguing for. Mr. Langstaff's words are (which Mr. Amesbury quotes), "The foot was everted, and there was shortening of the limb at this time, and after death it was shorter than the other *full two inches and a half*." * * * "The capsular ligament was immensely thickened, and embraced the joint very closely." Now these statements certainly give reason for suspecting that the ligament was torn through, for else how could the limb be shortened "full two inches and a half?" No doubt shortening may take place in simple transverse fracture, when the capsular ligament remains entire, but not to the above extent. The part of the capsule being "immensely thickened," implies that some great injury had been done to it, for in the majority of cases where it is not lacerated, it may be slightly thickened, but not to any marked degree; "it embraced the joint closely," which also implies laceration to have taken place, and the ligament to have been joined together, and to have adapted itself to the distance that existed between the portions of bone, owing to the displacement of the fractured ends.

If the capsule then were torn at the time of the fracture, an explanation can be found for the osseous

union that had taken place; for the opening in the capsule would admit of the ends of the bone being placed under the influence of the action of the surrounding soft parts, and so render the circumstances of the fracture similar to one situated in the shaft of the bone; but then this cannot be taken as an illustration of union, when the ends of the bone are insulated from such action, by the capsule remaining entire.

Another case is brought forward by Mr. Amesbury, which he describes as follows: "The upper third of the femur was taken out, and when the soft parts were removed, the head of the bone was seen depressed in a line with the shaft. * * The posterior surface of the shell of the neck had the appearance of having been splintered, so as to make a part of the fractured end of the pelvic portion extend in one situation a *little external* to the capsular ligament; but it is worthy of remark that that portion of the fractured end which might by some surgeons be considered external to the capsule was not united." This case I should not accept as illustrative of the kind of union it is meant to prove; for the fact of its being *external* to the capsule alters the circumstances altogether, and would allow of sufficient action taking place to assist in the formation of the union that was found. The circumstance of the portion that was external to the capsule not being united by bone, proves nothing in my opinion, any more than if you were to find a fracture elsewhere only partially united.

I shall quote one more case from Mr. Amesbury's work, which I think supports the doctrine of non-union, and that it possesses points that go to disprove the possibility of the bony union taking place. The case was that of a woman, of 63 years of age, who frac-

tured both thighs, but at an interval of a little more than two years between the occurrence of the two fractures. The first fracture occurred in October, 1825, when she fell on the left side, and fractured the neck of the left femur; and "after the lapse of several weeks she was able to bear upon the limb, and could ultimately walk without support, having free motion in the joint; but in consequence of the *great retraction of the limb* and eversion of the foot, she usually availed herself of the assistance of a stick when in the act of progression." She fractured the right thigh bone in December, 1827, by a fall on the trochanter of that side, being more than two years after the first fracture; and there appears to have been no very marked signs of the fracture, for Mr. Amesbury says, that he ascertained the limb to be shorter, "by a peculiar mode of measurement," which implies that the shortening was not very evident. The patient died two months after the second fracture.

It was found on examining the parts after death, that the last fracture, namely of the right thigh bone, was not at all united, while the former one on the left side was joined by bone. Now with regard to the one that was not united, I say that it goes to prove that bony union cannot take place; for there is every reason to suppose that the capsule remained entire, from the retraction of the limb being so slight, that it was necessary to have recourse to "a peculiar mode of measurement" to ascertain it. This circumstance, I think, with the line of the fracture, which "extended through the neck of the bone, in a direction downward and outward, commencing at the upper part where the head joins the neck, and terminating at the lower part in a point, about an inch from the cartilaginous cover-

ing of the head," tends to show that the capsule was not injured; and therefore it may be rather quoted as one of non-union, when the capsular ligament is not torn, and support the view that I am now taking. On the other hand, on the left side there was found to be bony union, and there is every symptom of its having been fracture extending external to the capsule with laceration; for not only was there "great retraction of the limb, but on examining the part afterwards, there was found to be fracture of the trochanter also. But Mr. Amesbury says, "it was evident that this was quite independent of the fracture of the neck of the bone." Now I should say, that however little evidence there might be, and there might not be much, as the fracture occurred more than two years before; it is still highly probable that it did communicate with it, for I should think it next to impossible that the kind of force that is sufficient to break the neck of the bone, would at the same time produce a separate fracture of the trochanter; for an isolated fracture of the trochanter, can only be produced by a very peculiar kind of force, and one that would not be likely to tell on the neck of the bone afterwards. Not only does it appear improbable by reasoning upon it, but the preparations that exist prove the contrary; for I know of no preparation that shows the two fractures existing separately in the same bone, while there are many showing the fracture of the neck of the bone and that of the trochanter running one into the other.

It is highly probable then, that this fracture through the trochanter communicated with that of the cervix, and that this circumstance by itself, independent of the probabilities of the capsule itself being lacerated as well (and slightly torn it must have been by the frac-

ture extending through it), is enough to account for the bony union, and to make it of no value to support the doctrine of union by bone within the capsule, unaccompanied by laceration.

Another reason for supposing that in the ununited fracture of the right side, the capsule was not torn, is, that "In one part a portion of the reflected membrane, about half an inch remained entire, but was separated from the neck of the bone in such a manner as not to prevent the retraction of the limb." Now if a portion of the reflected membrane, which is so delicate, remained entire, I conceive it next to impossible that the force could have been sufficient to lacerate the strong capsular ligament; for had it been, this reflected portion must have been torn through too; for the capsule can only be torn by two forces,—one where the fractured ends of the bone are sharp and driven through it, and the other, where the force acts sufficiently after it has caused the fracture to tell upon the ligament, and tear it, by driving the shaft of the bone from the pelvic portion. There is no reason to suspect, from the description Mr. Amesbury gives, and from the drawing he inserts, that the fractured end of the bone could have produced it, for it extends transversely and entirely across the neck of the bone; and it could not have been torn by the other kind of force, or the portion of reflected membrane could not have remained connecting the two portions. The most probable conclusion then is, that the capsular ligament was not injured, and that consequently the preparation is one that well illustrates the non-union by bone of fractures of the neck of the femur, completely within the capsule; while that of the left side goes to prove that it may unite when the fracture extends external to the joint,

and where the ligament is lacerated, when the ends of the bone become similarly circumstanced to fractures situated elsewhere

These then are the cases that are brought forward to prove that fracture of the cervix femoris may unite by bone; and I have dwelt at some length upon them, because they are the most imposing in their appearances, of the few preparations that are quoted as evidence that such union may take place. At the same time I have endeavoured to give reasons for supposing them not to be sufficiently free from objections to make them at all decisive on the point, and that consequently there is still more reason to suppose that these fractures when unaccompanied with laceration of the capsule, cannot unite by bone; and that the reason why they cannot is to be found by comparing the circumstances under which this kind of fracture is situated, with those that are situated external to the capsule, and which can then be influenced by the action that takes place in the surrounding textures, and which action is so necessary for the production of ossific union.

Dupuytren, whom I have quoted, as one of the advocates for bony union, only mentions two cases in his "Leçons Orales," as tending to prove it; but in both the patients recovered, and he had not an opportunity of examining the state of the parts afterwards; so that there is no knowing in what direction the fracture was, or whether the capsule was torn or not. They therefore are of no value in support of the question. Desault also mentions two cases, but without the least proof that they were unaccompanied with laceration of the capsule, they are, for the same reason then, of no value. Having seen then how many acknowledged

authorities differ with regard to this subject of union of the neck of the femur, it becomes a natural question to ask upon what this great difference depends; for when we see great authorities holding two opposite opinions, there must be some cause for it, and we should be inclined to suppose that some misunderstanding on certain points must exist, rather than that one or the other should be absolutely wrong.

The only way in which this great difference in opinion appears at all explicable, is by supposing that those who advocate the possibility of bony union in this kind of fracture, do not distinguish sufficiently between those fractures where the capsule is completely free from injury, and those where it is injured in a greater or less degree; while at the same time they do not bear in mind the want of analogy that there is between a fracture confined within the capsule, and one external to it; for they appear to expect that the same process should take place in the two instances, when they are placed under such different circumstances, and when it is quite impossible that the same process should be capable of being produced in the one as in the other.

All Sir Astley Cooper's statements have reference to those cases only where the fracture is entirely within the capsule. His words are, "In all the examinations which I have made of transverse fractures of the cervix femoris, *entirely* within the capsular ligament, I have never met with one in which a bony union had taken place, or which did not admit of a motion of one bone upon the other."*

From the above statements that I have made, I think quite a sufficient reason may be found not only to

* Page 111.

dispute the evidence brought forward to support the doctrine of union by bone, when the fracture is completely within the capsule, and unaccompanied with laceration of the ligament, but to support the assertion of those who deny the possibility of it; for the numerous preparations that are preserved tend to prove it, as well as reasoning from analogy, and considering the process as it occurs in other parts of the bone, where the fractured ends are in contact with the surrounding muscles and cellular tissue. The want of analogy must be so apparent to all, that without it can be supposed that ossific union can take place by two totally different processes, I do not see how it can be supposed that fracture of the neck of the femur can ever unite by bone, when the fracture is entirely within the capsule and unaccompanied with any laceration of the capsule itself.

FRACTURE OF THE PATELLA.

THERE are many points of analogy between the patella and olecranon process of the ulna; for they both form a most important part of the joints with which they are connected. The patella facilitates the extension of the knee joint, in the same manner that the olecranon does that of the elbow.

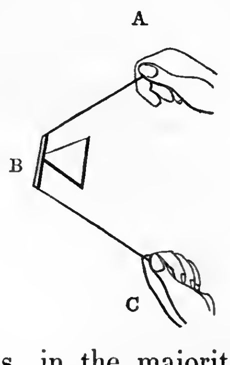
The size and shape of the patella are such, that we should naturally conclude, were we to look at the bone in its separate and unconnected state, that its fracture must be of very rare occurrence; yet this is by no means the case: for the great power which the muscles attached to the bone are capable of exerting upon it, under peculiar circumstances, is often sufficient to snap the bone across. On the other hand, its position is such that it becomes often exposed to injury, and is not unfrequently broken by violence directly applied. The fracture may be either simple or compound; and the former is the more frequent kind: the latter being very rare, and can only be produced by a very violent force, and one that generally crushes the whole joint at the same time.

The muscles inserted into the patella are four in number; namely, the rectus, the curæus, and the two vasti, and their office is to extend the leg; from which circumstance they have received the name of quadriceps extensor cruris. It is these four muscles that perform the important office of preserving the erect position of the body upon the lower extremities, in

the act of standing, as well as bringing the pelvis forwards upon the leg in the act of walking: so that viewing them in this light, they will be seen to be in constant action during either of the above positions; and the only manner in which they can so act, is by means of pulling upon the patella, and, through this bone, upon the ligamentum patellæ; which ligament is attached to the large tubercle placed on the anterior part of the tibia, just below its head. All the force they exert, then, tells upon these two points, namely, upon the patella itself, and upon its ligament: but this ligament is fixed, and so becomes a counteracting force; and is therefore equal to a force pulling in the opposite direction, when the powerful muscles above described act and pull the patella upwards, so as to put this ligament on the stretch, which they must do before any influence can be gained upon the joint itself.

One great point of difference that exists between fracture of the patella and that of other bones, is, that the patella is oftener broken by the action of the powerful muscles attached to it, than by any other kind of force—while just the contrary is met with in fracture of other bones. The reason of this kind of force so often acting upon the patella is, as already stated, owing to the very powerful muscles that are attached to it. There is, however, another cause that greatly facilitates their action, namely, the position of the bone; for it will be seen, by referring to the structure of the knee joint, and to the part the patella takes in forming it, that when the joint is semiflexed, the bone, instead of lying flat between the two condyles of the femur, as it does when it is in a state of extension, is now brought into a position that allows of only a

portion of the bone resting completely on them: for while its transverse diameter is in contact throughout, its vertical one is not, but is merely supported in its centre: so that, in point of fact, so small and strong a bone as the patella is, becomes placed in the most favorable position for a force to act upon it, by giving the muscles a lever power which pull upon the upper edge of the bone, and the ligamentum patellæ which pulls upon the lower; while the condyles of the femur form a fulcrum for the bone to rest upon. The position of the patella with regard to the condyles and muscles, in this case, is seen in the wood-cut; and the same thing may also be exemplified in a more familiar manner, by referring to the figure adjoining it. Let B represent the patella resting on the fulcrum, which is gained by the end of the femur; and A, the force that is applied in the direction of the quadriceps muscle; while C marks the line in which the ligamentum patellæ pulls, when the tibia is brought obliquely forwards. A and C have only got to act with sufficient violence, and they will break B across: and this is precisely what happens when a person fractures the patella by the action of the muscles.



Although the patella is, in the majority of cases, fractured by the action of the muscles, it is not un-

common to find it produced by direct violence applied to the bone itself; as when a person strikes the bone against any hard body, or receives a blow upon it, as a kick from a horse, &c. This latter kind of force is found to make a great difference with regard to the circumstances under which the fracture is placed, and also makes a difference in the process of union, which I shall explain presently.

These two kinds of forces, then, which produce fractures of the patella—the one being by muscular action only, without any violence directly applied to the bone itself—the other being by direct violence only, and without any effort of the muscles—renders it necessary to consider the fractures of this bone under two distinct heads, namely, those produced by the action of the muscles, or by the indirect force; and those produced by the direct force, when the violence is applied directly to the bone itself. The importance of this division will be seen when the different effects the two kinds of fracture have produced are explained. I shall first consider the fracture that occurs by the indirect force, or by the action of the muscles.

The common way in which fracture of the patella takes place, when produced by the violent action of the four large muscles inserted into it, is the following. A person, either walking or running, slips with one or both feet, so as to bring the legs in a position that the knees become semiflexed, at the same time that the body also becomes so placed, that he finds himself falling; and, to prevent which, he suddenly makes an effort with those muscles which tend to straighten the knee joint, so as to throw the trunk of the body towards the erect position. It will be seen, by this violent action of the muscles which must

take place in order to produce this altered position, that the whole force will come upon the patella and its ligament; for, at the same time that the joint is extended, the thigh bone has to be brought towards the perpendicular, by which the trunk is at the same time carried with it, and its position redressed. It is just at the time then when the knee joint is so bent, that the patella is placed under the most favorable circumstances for the muscles to act upon it; and it is at this moment that the muscles themselves act most powerfully: for the difficult point is to extend the joint just when the body is falling in a direction that is tending to flex it still more. And if the bone and the ligament be strong enough to resist the first effort of the muscles, they immediately are removed from all danger of fracture; for the line of the force becomes altered, and tells in a straight line with the bone, more and more, as the joint becomes extended; but if either the ligament or the bone be not strong enough to resist the violent and sudden action of the muscles, the one or the other gives; and the patella is the part that always does, for its situation and position with regard to the end of the femur, place it under circumstances that the ligament is not; and the bone is found then to snap across, and to be separated into two portions. The patient then, of course, looses the only hold he had upon the joint, in the way of extension, and falls to the ground. So very peculiar and distinct is the fracture of the patella, when caused in this way, that the patient will, in the majority of cases, be able to tell that the bone snapped across, and that he felt it do so before he fell to the ground. It does not always happen that the patient can tell you this; for they often say that they fell completely

to the ground, and that the blow caused the fracture; but the fact of the nature of the accident, which is generally such that the patient was falling in a peculiar direction, place the limb under the circumstances that I have mentioned above; as well as the fracture being in one place only, and transversely across the bone, are sufficient reasons for deciding that the fracture was caused by the action of the muscles, and not by the application of the direct violence, although the patient may not be able to tell you that he felt the bone break before he fell.

It does not, however, necessarily follow that the patient falls to the ground after this kind of injury, for sometimes the muscular effort of the opposite leg is sufficient to save him, although the other patella be broken. In those cases when the patient does not fall, I think it will be found that the bone has snapped across with a comparatively slight muscular effort, and when the body has not been so much out of the perpendicular; so that the danger of falling has not been so much, nor the effort required to redress the position of the body so great.

The appearance of a bruise may help the diagnosis; for if there be ecchymosis, it is in favor of the direct force having been applied to cause the fracture, though it cannot be taken as a sure sign; for a fall on the knee afterwards might produce the same appearance, though this would not be so likely to cause a bruise as the other kind of force.

Desault mentions a case where a patient broke both the patellæ at once, by a violent effort of the muscles, to disengage his limbs from the confinement they were placed in for the operation of lithotomy; the sudden attempt at extension, was sufficient to break both the

patellæ across. If the different circumstances under which the patella and muscles would be placed during this action are considered, it will be found to afford a good illustration of the kind of force that causes the fracture by what is called muscular action only. He also mentions another case, where a soldier fractured the patella while attempting to kick his serjeant.

It does not, however, always happen that the patella snaps; for sometimes, though rarely, the tendon of the quadriceps muscle gives just at its insertion into the bone. A case of this kind occurred at the Middlesex Hospital about two years ago, in which a space existed above the bone wide enough to lay two fingers in. This may depend on two causes, the one where the tendon is weaker than natural, the other where the patella is stronger; or when the end of the femur is less prominent at the point where the patella rests, so that the bone lies more closely in contact, and of course under more favorable circumstances to resist the peculiar action of the muscles upon it, and so throwing more stress upon the tendon by the bone not breaking. I have never seen a case where the ligamentum patellæ was ruptured, though I remember one in which there were reasons from the sensation communicated to the finger when placed upon the part, to suspect that such was the case. It could not be said to be so for certain, however, for the man had fractured his patella by a previous accident, and was admitted into the Middlesex Hospital a second time for fracture of the same bone; there was still a separation between the old fracture, and one also *below* the lower portion of bone with a prominent edge, which gave very much the sensation of a rupture of the ligament, for no bone could be felt below this depression; but

this might only have been owing to thickening of the parts from the old fracture. Had the bone not been fractured above this depression, it would have been more easy to decide as to whether the lower depression was owing to the ligament being ruptured or not; for if the whole bone above were entire, it would have presented its usual shape, and admitted of measurement with the sound one of the opposite side; and any depression then in the same situation would have admitted of the lower margin of the patella being felt, and have decided as to the ligament being ruptured or not; but the position of the bone was quite altered, as well as the shape of it, so that I should not quote this as one of the above injury. Another circumstance against it being rupture of the ligamentum patellæ is, that it would be more reasonable to expect the ligament formed between the fractured portions of bone to give, rather than the strong ligament that is united with the tibia.

When the patella is broken by the direct force, the manner in which it acts is easily understood; for violence from any hard body, when sufficient, will cause the bone to break. Examples of which may be given, by supposing a person riding on horseback, and to come suddenly against a post with the knee; if the blow tells directly in front of the bone, it will be likely to break it; but if it tell so as to strike the edge of the bone, it will be more likely to produce dislocation in the direction in which the force is applied. Another example may be given, by supposing the person to receive a kick from a horse, or to fall from any height, and to strike the knee against some hard body. A fall directly on the patella from the erect position, is given by some as a cause sufficient to produce its

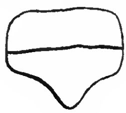
fracture. This may be, when the person is running, and suddenly falls on the knee; but simply falling from the erect position, as in walking or standing, will not be sufficient, for the small distance that exists is not enough to give an impetus to the force to allow of its breaking a bone like the patella.

When speaking of fractures of other bones, I stated that it generally happens when the injury has been produced by the direct force, the consequences that follow are of a more serious nature than when it has been caused by the indirect force. The same statement applies to fractures of the patella, and in a greater degree; for here the bone is situated in the joint, and forms a large portion of it; and any injury sufficient to cause its fracture by direct violence, must, at the same time, do great mischief to the joint itself, both from its immediate effects and from the consequences that must arise afterwards.

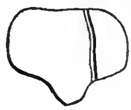
The symptoms of fracture of the patella vary according to the kind of force that has produced it. When caused by the indirect force, it generally happens that the bone is broken at or near its centre, and transversely across, as A in the wood-cut; it may also extend obliquely,—when the centre of the bone does not break, the fracture is found to take place below this point, and seldom above it; for the upper part is much thicker and stronger than the lower, and so less likely to yield. The manner in which the bone is broken when the muscles act, is such that it cannot be separated into more than two portions, at least I have never seen it fractured in any other way, nor am I aware of any cases being on record.

The fracture may take other directions than that of transversely or obliquely across the bone. It may extend

perpendicularly through it, (B); or extend in many directions, so as to comminute it, and separate it into many portions, (C). When it takes this direction, however, it is generally, if not always, produced by the direct force; and it will be easy enough to understand how a smart blow on the patella may break it into many pieces, and in many directions.



A



B

C

The perpendicular fracture, though rare, does sometimes occur. I do not remember to have seen more than one in a living person, but there are three or four specimens preserved in the Museum of the Middlesex Hospital School, and an interesting point in these specimens is, that two of them are quite united by bone.

The situation of the fracture is seldom through the centre of the bone, whether it be transverse or perpendicular, for this part is the strongest. It is however oftener nearer the centre in the transverse than in the perpendicular. I have seen many specimens of this latter kind, and they are all to the outer side of the central vertical ridge, which projects posteriorly between the condyles, and so strengthens the bone in this direction. In the transverse fracture, it sometimes happens that a very small portion only is separated, rendering it difficult to understand how the muscles could act so as to break the bone so near to the edge, rather than towards the centre. There is a patient now in the Middlesex Hospital, in whom the right patella is fractured above the transverse centre, so near

to the edge as to leave not more than half an inch, and hardly so much, connected with the quadriceps muscles. As a general rule, however, I think it will be found that when the fractured portion separated is very small, that it is in the lower portion; for the narrow portion that is immediately connected with the ligamentum patellæ, is the thinnest and weakest part of the bone, and so more easily acted upon than the upper and thick portion.

When the perpendicular fracture occurs, the force must be so applied as to strike the patella when the knee is partially bent, which position brings the bone more towards the edge of the condyle, and makes it rest on the most prominent part of it; a smart blow applied more towards the edge than the centre, will be likely, under these circumstances, to fracture it perpendicularly. It is rare, however, for the direct force to strike the bone in this manner; most generally it includes the central portion as well, and will then of course be likely to break it in many directions, constituting the comminuted fracture.

The fracture sometimes takes an angular direction, so as to leave one portion fitted within the other. A case of this kind I lately saw in the Middlesex Hospital: a man fell and struck his knee against the edge of the curb stone; the fracture took a direction so as to leave the lower portion projecting angularly upwards, fitting into the upper,—the line of fracture could be distinctly traced, as represented in the wood-cut.

The many different directions the fracture may take, will cause a difference in the kind of displacement that will exist between the portions of bone; for accordingly as the fracture is simply transverse, or perpendicular,

or comminuted—so will the separation be to a greater or less extent, being much more in one than in the other kind.

When the fracture is transversely across the bone, as it is when produced by the action of the muscles inserted into it, the displacement that takes place is often great, and generally sufficient to indicate at once the nature of the injury, owing to the separation that exists between the two portions of bone. In the transverse fracture, both portions are displaced; that is to say, the upper is pulled upon by the powerful muscles attached to it, and retracted to a greater or less extent up the thigh; while the lower one recedes to a certain extent, both from the elasticity of the ligament which will have an effect in drawing it downwards, at the same time that the want of resistance, which will so suddenly cease when the bone snaps, will favor this elasticity of the ligament, by its having been previously put more than usual upon the stretch. It is quite erroneous to suppose that no displacement takes place in the lower portion; which opinion I was myself inclined to support, until I paid particular attention to this kind of fracture; for it will be found that this lower portion can always be brought upwards to a certain extent towards the upper, shewing that it must have receded to allow of this being done. If this displacement downwards does not take place immediately at the time of the fracture, it will afterwards; for the least degree of flexion of the knee joint will pull this portion of the bone with it downwards, and will then not be redressed again when the joint is extended; for the force that would act upon it is now absent, owing to the fracture giving all the influence of the muscles to the upper portion. Experience has taught me that

great advantage is gained in the approximation of the two portions of bone, by applying pressure to the lower as well as to the upper.

The degree of displacement that may be produced in the upper portion, will depend upon many circumstances. The power of the muscles is greater in some people than in others; in a strong muscular man more displacement will be expected, than in one whose muscular power is weak. Again, the circumstances under which the bone was broken will also influence the degree of separation; for when it is fractured under any violent exertion, such as running fast and slipping suddenly, the muscles will be liable to act more violently, than if a person were walking and fell without any great force; the exertion the muscles make will not then be sudden and violent, as in the former case, nor will they act so much upon the portion of bone after producing the fracture. Another circumstance that will influence the displacement, will be the degree of laceration of the capsular ligament; for though this ligament may allow displacement to take place, owing to the loose manner in which it is connected to the patella, without any part of it being much torn; it will still have power to prevent retraction beyond a certain extent. This ligament then must be torn at the same time that the bone is fractured, or afterwards, to allow of any great retraction upwards of the bone. Although the retraction may not be great at the time of the accident, it may be increased afterwards; for the patient may be awkwardly carried, with the joint flexed, which position will displace the portions of bone; and even if the limb be kept quite extended, the retraction may go on increasing, for the muscles will contract gradually without any additional

stimulus being given to them, simply from having lost the natural resistance that was offered to them before the bone was fractured, which brings them under circumstances similar to what they are placed in when the muscle itself is divided across; the only difference being, that in the latter instance the fibre contracts in two directions, while in the former it does so only in one; for it now has only one fixed point to act from, instead of two, as it has when the muscle itself is divided. The causes of displacement then in the transverse fracture may be said to be,—1st, The immediate action of the quadriceps extensor cruris muscles.—2ndly, The degree of laceration of the capsular ligament. 3rdly, The natural contraction of the muscular fibre which takes place gradually, after the immediate and sudden action has ceased, owing to the resistance that is naturally present being removed. 4thly, The descent of the lower portion, which, when the bone is broken, will recede from the upper (though comparatively for a small extent), when the ligamentum patellæ loses its resistance which it had from above, and in so sudden a manner. 5thly, Mal-position of the limb, by allowing the knee to be flexed, when the two portions of bone are separated from one another, and are not able to be redressed when the joint is extended, there being no continuity between them.

Owing to one of the above reasons, namely, the contraction of the muscles taking place some time after the injury, it is not uncommon to find the upper portion of bone much more displaced two or three days after the fracture, than it is at the time of the accident; from which fact an important point in the treatment is indicated, namely, to employ such means as soon after the fracture as will prevent this subsequent retraction taking

place, even if the portions of bone themselves cannot be brought into direct contact. I shall presently show that this admits of being done immediately after the fracture, by employing means that are capable of fixing the portions of bone without making any constriction on the joint generally, so that any swelling that may arise subsequently, will not render it necessary to discontinue the apparatus, nor to disturb the apposition of the portions of bone.

This point of gaining the immediate apposition, is much more important in fractures of the patella or olecranon, than in other kinds of fracture; for here the portions of bone are so small, and the muscles connected with them so powerful, that any retraction that may be allowed to take place and to remain for a long period, will displace the bone to a great extent, and render the muscles so much contracted, that they become accommodated to their new position, and the fibres become so preternaturally shortened, that it is often quite impossible to elongate them sufficiently, to bring the portion of bone connected with them down enough to meet the lower portion; the consequence of which is, that direct apposition is never got, but a kind of ligamentous union produced, instead of giving the parts every opportunity of being joined by bone. This circumstance must have been evident to every one who has had opportunities of seeing this kind of fracture; for in the first instance, immediately after the fracture, the two portions of bone can be easily brought into contact, whereas in the course of two or three days the contraction of the muscles that has been gradually going on since they lost their resistance, owing to the fracture, has caused the bone to be drawn up to a greater or less extent; and now instead of

being easily replaced, there is great opposition made, and in many cases it is impossible to bring the two portions of bone into direct contact; for the long continued contraction and the new position of the muscles, cannot be overcome, and a space exists between the two fractured surfaces that might have been obviated, by employing means from the first to prevent this retraction taking place.

Not only does displacement take place by the separation that is produced between the two portions, from the causes above mentioned, but another kind of deformity is often produced, namely, the depression of one portion more than the other, by which the level of the two is lost and a consequent deformity produced. This sinking of the one portion below the other, is generally found to take place when the bone is broken near to the edge, for then the one portion is so small that it sinks between the condyles. This does not take place when the fracture is near the centre of the bone, so as to leave the two portions of a large size, for then their size is sufficient to prevent them sinking to any great extent below their natural level, so as to create much deformity.

It will be found that when this depression of the one portion below the other exists, it is most frequently caused by the upper portion sinking below the lower, and that the lower remains at its natural level. The reason of this is, that the space between the two condyles of the femur is much larger than the space opposite to the lower end of the patella; so that there is more room for the upper portion of the bone to sink into than there is for the lower, which sooner comes in contact with the head of the tibia than the upper portion does with the surface of the condyles,

and consequently cannot sink so far. This difference in the level of the two portions will also be increased by the flexion of the knee; for then the lower portion is rendered more prominent by the head of the tibia, and will form an angle with the femur and upper portion: this is one reason, then, for keeping the knee extended as much as possible during the treatment.

The extent to which the upper portion may be retracted differs very greatly, and is dependant on the causes already mentioned. Sometimes it is only slight, there being just sufficient separation between the two portions to show that a solution of continuity exists; but these cases as already stated, do not always remain in this favorable state of apposition, for any attempt the patient may make to move the limb, may displace it more afterwards; and even if the limb be kept perfectly steady, and no such attempts be made, the natural tonic contraction of the muscles, which goes on gradually when their point of resistance is lost by the bone being broken, is sufficient to cause the upper portion to be retracted for an inch or more.

In some cases where the force has been very violent, so as to cause the muscles to act upon the portion of bone after the fracture, the separation may take place immediately, and often to an extent of two inches and more. In these cases the displacement is seldom increased afterwards; for the muscular fibres are already relaxed to their extreme point of shortening, and only have to accommodate themselves to their new position, which they can do without causing any alteration in the position of the portion of bone connected with them.

This separation between the two portions of bone does not only take place at, or shortly after the frac-

ture is produced, but may be caused many weeks after the injury, when a strong ligamentous union has joined the two portions of bone together; and this, as I shall have presently to state, is one of the unfavorable circumstances, that almost always attends this fracture; for although for the first few days, or perhaps weeks, after the patient begins to walk, the ligamentous union may appear sufficiently strong to keep the portions of bone in the apposition into which they have been brought during the treatment, and so give hopes of the patient having a useful limb, although not so strong as before the fracture. But this does not remain, for as the patient gains a little strength and motion of the joint, he is inclined to use it more, and to exert those muscles which are attached to the upper portion of bone; the consequence of which is, that although at the first the new ligament formed was sufficient to oppose the slight motion that was exerted upon the joint, it is not now strong enough to resist the new force that the muscles make upon it, and the more the joint is moved the more power the muscles gain; so that the ligament yields little by little until at last the apposition of the two portions of bone is entirely lost, and the joint becomes weakened to such an extent, that it is almost insufficient to support the patient during the act of progression, much less to perform any more active exertion. I have seen many cases where at first the portions were so close in contact, as to give almost the hope of bony union being produced, but which soon afterwards, when the patient came to move the joint, gave proofs of it being only ligamentous; for the two portions were gradually separated more and more, until a space of from two to three inches, and sometimes more existed between them. I

remember seeing a case of a woman, who fractured both patellæ at different periods, in whom the upper portion of bone was drawn in the one limb full half way up the thigh, and in the other three inches; she could still walk without any other assistance than that of a stick in one hand.

When the perpendicular fracture occurs, little or no displacement takes place, for there is now no muscular force to separate the two portions of bone. They are kept in contact by means of the tendon of the quadriceps muscle, that is inserted into the upper margin, and by the ligamentum patellæ that is inserted into the lower margin, as well as by the general capsule which takes hold of the circumference of the bone.

This kind of fracture is not always easy to discover, owing to the above circumstance of the absence of the separation between the two portions of bone, and it is rendered still more difficult when any swelling is present. The symptoms of it are, however, motion between the two portions, with a crepitus, and sometimes slight separation, which may be increased by flexing the knee joint; after union has commenced, a ridge may be felt in the line of the fracture. This kind of fracture is also generally accompanied with more pain and swelling, owing to its being produced by the direct force, which causes more violence to the joint. I have only seen one case of it. The third kind of fracture of the patella,—that which occurs next in frequency to the simple transverse, is the comminuted fracture, produced by direct violence being applied to the bone itself. The peculiarity of this kind of fracture, as compared with the transverse, is that the portions of bone are but slightly separated from one another; the reason of this is, that the covering of the bone which is formed

by the capsule, and by the tendon of the quadriceps, which sends a process of fibres across its anterior surface, is not torn through, so that the fractured portions are still kept in contact by these means; and little or no displacement is produced by the muscles pulling upon them, or by the position of the joint being altered. One evil that follows this kind of fracture, is, that more inflammation is likely to arise in the joint; for, at the same time that the direct violence breaks the bone, it must also injure the internal part of the joint upon which the bone rests; though as far as the bone itself is concerned, this inflammation does not do harm, for it assists in the consolidation of the portions of bone, and so brings them more under the influence of that process which takes place in fractures elsewhere, and so is more likely to ensure the bony union being produced than the ligamentous.

In the comminuted fracture, caused by the direct force, the portions generally admit of being freely moved upon one another, and allow of a crepitus being easily produced. There is no difficulty in discovering the nature of the injury, if the patient be seen shortly after its occurrence; but if some time elapse before an opportunity is given to examine the part, swelling may come on to an extent so as totally to preclude the possibility of telling whether the bone be broken or not. In this respect this kind of fracture differs from the simple transverse; for then, although the swelling may be great, the pressure will generally allow of the finger being depressed between the two portions of bone, and so discover the line of separation between them; but this must not be taken as a general rule, for if the retraction of the upper portion be only slight, and the swelling exist to a great extent, the same dif-

ficulty will be present, and prevent the discovery of the fracture in this as in the former kind.

Swelling of the joint is a symptom that is present in almost all cases of fracture of the patella; but the period at which it comes on, and the extent to which it takes place, vary; for it will be found that in those cases where the fracture is produced by the action of the muscles, the swelling often does not come on for some hours after the accident, and sometimes never becomes very great; but, as a general rule, it will be found that, at the end of four and twenty hours, the tumefaction is considerable, and that the portions of bone are more separated than immediately after the accident: the peculiarity of the swelling in this case is that it takes place gradually.

In the fractures by the direct force, the swelling is generally greater than in the former instances, and takes place more rapidly; for here, not only is the part of the joint immediately connected with the bone injured, but other parts as well, rendering it complicated with bruising of the delicate synovial membrane, which is reflected on other parts of the joint, at the same time that the membrane covering the bone is now bruised, owing to the kind of force that produced the fracture, and the many directions in which it extends.

With regard to the nature of the swelling, I have not myself had an opportunity of examining the joint immediately after a fracture of the patella, nor do I know of any authority that states to have done so. It is most likely that the larger portion of it is synovia effused from the injured membrane. Some blood no doubt is extravasated at the time of the fracture, both from the surface of the bone as well as from the membranes that are torn through. In the cases where the

direct force causes the fracture, so as to comminute the bone, no doubt the blood exists in a larger quantity than in the simple transverse fracture: in this latter case, the probabilities of the swelling being chiefly caused by the effusion of synovia into the joint, and of serum in the neighbouring cellular tissues, is rendered more likely by the gradual manner in which the tumefaction takes place, while in the former case it comes on much more rapidly. I have had opportunities of seeing one case of compound fracture of this bone examined, in which, as might be expected, the effusion was chiefly blood.

The shape of the swelling is not like that of a simple effusion into a joint in its natural state, but is more regular and globular in its form: for owing to the patella being broken, and the retraction of the upper portion of bone, the synovial membrane is drawn up with it, and destroys the double pouch that exists when the patella is in its natural state, round the insertion of the quadriceps muscle, caused by the peculiar manner in which this membrane passes up under the two vasti muscles. I remember seeing a case once, which I think worthy of relating; as a mistake was committed that is quite possible to occur. A man fell down, and, as he says, struck the knee; but he could walk about afterwards, though not without the help of a stick. He did not apply for any advice till four days after the accident; and, when seen by a surgeon, the whole joint was immensely swollen, having a regular globular shape, and not that of the ordinary effusion into a joint; no patella could be felt; there was great tension and pain. The circumstance of the man having walked about (though but lamely) for three or four days, and the accident having, according to the man's

account, been caused by a blow upon the knee, never led to suspicion of a fracture of the patella. The joint, however, was examined when in this immensely swollen state, and no patella could be felt; the conclusion come to was, that the nature of the swelling was effusion into the bursa of the patella, which accounted for the absence of the bone, and that there was great effusion also into the cellular tissue around the joint. The man was treated accordingly,—had leeches, fomentations, &c. applied, and was kept constantly in bed; the swelling went down very gradually, and at the end of a fortnight had sufficiently subsided to allow of a more minute examination of the joint, when to the great surprise of the surgeon, it was found that the patella was broken transversely across, and that the upper portion was greatly retracted, which fully accounted for the absence of the bone when felt for in its natural position. This error in the diagnosis, however, did not affect the treatment, for had it been discovered sooner, no other remedies could have been applied, owing to the swelling that was present when the man first applied for advice.

I may also mention another case as illustrating symptoms that resemble fracture of the patella, without such actually being the case. Simple effusion into the bursa of the bone, when in a small quantity, will give the sensation of there being separation in some part of it, precisely in the same manner as effusion under the scalp gives that deceptive feel to the fingers when it is pressed upon, that so much resembles depression of a portion of the skull. In the case of the patella, the bursa may become thickened in parts, and so give the sensation of ridges on the surface of the bone, after all the effusion has been removed.

I shall describe the case, and the points that are to be observed to avoid mistaking one of this kind for that of fracture.

Case.—Mary Campbell, æt. 38, fell down the kitchen stairs, having trod on a piece of coal; says she went down thirteen or fourteen stairs, and struck the knee when she came to the bottom against the edge of the stair. She was admitted two hours after the accident, the knee was then greatly swollen, and painful. The sensation given to the fingers, when pressed upon the bone, was exactly like that of a comminuted fracture. There were apparently two or three divisions; one extending transversely, and others rather obliquely. These, however, were found not to be owing to fracture; for, on the swelling subsiding, it was ascertained to be only thickening and effusion into the bursa. There was also a sensation of the portions of bone moving: this was however found to be only the fluid effused. She got up about ten days after the accident, and could walk as well as ever, all the swelling of the joint having subsided: there still remained the ridge and depressions on the bone, giving exactly the sensation of the bone being in two or three portions. It was now however distinctly ascertained to be dependant only on the thickened state of the bursa; one sign shewing that the bone was not fractured, was, that the ridge and fissures could not be traced along the margin or edge of the bone, but only on the upper surface; which they could have been had there been fracture. She left the hospital in three weeks, the knee being quite sound and well.

Had the above case not been caused by an injury, of course no thought would have existed as to there being a fracture, but the patient having struck the

knee, and there being the peculiar sensation given to the fingers when the part was examined, rendered it at first sight probable that there might be fracture; though, when minutely examined, it could be satisfactorily proved that such was not the case. The degree of pain, like the swelling, in the first instance, is more or less according to the manner in which the injury has been produced; for when by the indirect force, as when the action of the muscles is the cause of the fracture, it is comparatively trifling; for it will be found that the patient can at first bear the joint to be examined without much inconvenience, whereas, if the fracture has been caused by the direct force, the slightest pressure is often sufficient to give great pain, and this very shortly after the accident. The pain also, in this latter case, gets to a higher degree than in the former; in fact all the symptoms are aggravated when the bone is broken by a direct blow, as might be expected, from the nature of the force that then acts to produce the injury. The duration of the pain varies according to the severity of the injury: as a general rule, it will be found to remain as long as the swelling exists to any great degree, and as this subsides, the pain will likewise;—the period is from ten days to a fortnight. Before speaking of the treatment of fractures of the patella, I shall briefly recapitulate the symptoms.

I have said that fractures of the patella may be produced in two ways—either by the direct force, or by the indirect, and the symptoms are classed accordingly: thus, in fractures produced by the direct force, as when a blow strikes the bone, there will, as a general rule, be little or no separation of the fractured portions. The fracture may extend in any direction,

and in many at the same time, constituting the comminuted fracture: this kind may also be attended with laceration or contusion of the soft parts; laceration however is but rarely found. The direct force is the only kind that can produce the vertical fracture; for both the peculiar shape and situation of the bone, and the position and action of the muscles, render it impossible for the indirect force to tell through its vertical diameter. In the vertical fracture, the only separation that can take place is laterally, and this in a very slight degree. Swelling of the whole joint comes on earlier, and to a greater extent, in the direct fracture, than when caused by the action of the muscles; the pain is also greater. When the patella is fractured by the indirect force, the most prominent feature is the separation that is found to exist between the two portions; sometimes it is but trifling, and often to a very great extent, for two or three inches or more: this symptom alone is sufficient to form the diagnosis; and is generally so easily discovered, that no doubt of the nature of the injury can exist, when the patient is seen at an early period. This separation I have also stated to be dependant on many causes; and to be increased or diminished according to the manner in which they act. Swelling and pain are also attendants on this latter kind as upon the former, though not always to so great an extent.

TREATMENT OF FRACTURE OF THE PATELLA.

In speaking of the general principles of treating fractures, I have mentioned the great importance of thoroughly understanding the anatomy, and peculiar action of the muscles; for, with few exceptions,

scarcely any bone can be fractured without the portions into which it is broken being brought, more or less, under the influence of the muscles that are attached to it; and to be liable to displacement, and to cause deformity, if union be allowed to take place without the proper apposition of the fractured portions being first obtained.

In no fracture are the portions of bone so much influenced by the muscles as in that of the patella; for the size of the bone and its situation, and the powerful muscles inserted into it, all place the fractured portions under circumstances highly favorable to be displaced by the action of the muscles; for when we consider that in the majority of cases the patella is broken by the action of the muscles only, we can easily account for the degree of separation that often exists afterwards; for the same muscles still remain to act upon one of the portions of bone, and with the advantage of now having no resistance to overcome, owing to the lower portion being completely unconnected with it. We have, then, in treating this kind of fracture, to consider many points besides the mere local application of means to preserve the contact of the portions of bone.

The position the knee joint should be placed in is at once indicated, when the relative position of the fractured portions is considered, in the two different states of flexion and extension. In the state of flexion, the two portions of bone are separated from one another, quite independent of the action of the muscles; for when the knee joint is bent, the tibia takes the lower portion of bone with it, by means of the ligamentum patellæ, and so carries it from the upper one, which remains stationary, and a space between them is necessarily produced. Extension of the joint then,

on the contrary, acts in remedying this, by bringing the lower portion towards the upper; and which is one important reason why this position should be employed rather than that of flexion. But there is another very important reason why extension should be employed rather than flexion, namely, because it tends to relax the powerful muscles that are inserted into the upper margin of the patella, and enables the upper portion of bone to be brought down to the lower, with more facility than it could be were the joint in a state of flexion. Another advantage also gained by extending the joint is, that tension and pressure are taken off from its inner surface; for extension relaxes the capsular ligament, and allows the effusion to take place with less confinement, and so gives more ease to the patient, and tends to diminish the irritation that otherwise might be produced.

The above, then, are the objects gained by extending the knee joint: but this is not the only joint that has to be considered; for one of the muscles that take hold of the patella is not connected with the femur, but passes up before the hip joint, and takes hold of the anterior inferior spinous process of the ilium, namely, the rectus; and this is one of the most important extensors of the knee, and consequently has to be relaxed as well as the others. This is, of course, to be done by flexing the hip joint by bending the thigh upon the pelvis, and so bringing the two extremities of the muscle close to one another: this will be facilitated by raising the pelvis forwards also; which is done by inclining the shoulders and spine, at the same time that the thigh is inclined upwards; more relaxation is thus gained than will be by raising the thigh only. This position is best obtained by employ-

ing either Earle's or Amesbury's bed, which, from their peculiar construction, admit of forming an angle in the middle, and of being so placed that the heel and shoulders can be raised at a higher level than the pelvis, and allow of any degree of flexion of the hip joint being produced. If the above beds cannot be obtained, the same principle can be got by two pieces of board, so nailed together that the shoulders and heels can be raised in a similar manner. Sometimes it is only necessary to raise the leg, and not the shoulders, which can easily be done by pillows. Not only does this position relax the muscles to the utmost, but it also takes off all disposition in the patient to move the limb; for when the pelvis is made the lowest part of the body, the whole trunk becomes fixed and evenly supported. The elevated position of the leg and knee may also tend to subdue the local action of the blood vessels around the joint, by returning the blood more freely than it would be were the limb placed at the usual level.

The above is the position, then, in which the patient is to be placed, as soon as the bed can be got ready; for so long as the limb is left hanging down, or placed horizontally, if the muscles be not completely relaxed and the patient's body at the same time quite at ease, he will be disposed to move the limb, and so be liable to disturb the portions of bone, and produce more displacement than already exists; for I have stated how many circumstances tend to cause the separation of the one portion from the other, and for some time after the fracture has been produced.

Having got the patient upon the bed, the next point to be considered is, what means are the best to employ to bring the two portions of bone into contact, and to

keep them there; for this fracture is unlike others, where often all that is necessary to do is to relax the muscles, and to reduce the displaced portions, and they keep there without any further means, so long as the whole limb is kept quiet. But in fracture of the patella, however much the muscles are relaxed, and however easily the upper portion of bone is brought into contact with the lower, it will not remain there by itself, if there have been much separation at first. In those cases where the two portions of bone have been but very little separated, there is of course not the same difficulty existing as in the former, where the retraction has been great; and these must be the cases (and very rare they are), in which some say that no mechanical means are necessary to treat fractures of the patella with, but that simple position is sufficient. I do not consider it necessary to further refute the doctrine of non-treatment of fractures by splints; for any one of experience must know that the cases that do not require splints are the exceptions, and that the general rule is, that in by far the greatest number much benefit is derived from their use, and that in many the prevention of deformity altogether depends upon their employment.

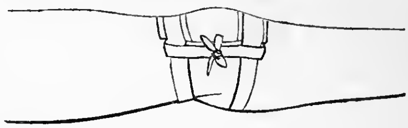
Position alone, then, not being sufficient to keep the fractured portions in contact, some mechanical means must be employed; and here it will be found that many different kinds have been recommended in this fracture as in others, and although the principle of them is much the same, still there are some which are more fitted for this peculiar kind of injury than the others. I shall first of all describe the apparatus that seem to be most likely to answer the purpose for which they are employed, and shall then give one that I have my-

self recommended, and which appears to me to possess advantages which the others do not.

The materials employed are either bandages, straps, or pieces of metal; so contrived that they keep the two portions of bone more or less in apposition, according to the power there may be of bringing the upper portion down to the lower;—of course no instrument or contrivance can keep the portions of bone closer than their reduction admits of.

The most simple means employed, and the most easily obtained, is the common bandage, with the aid of compresses; it is applied as follows,—the foot and leg are first to be rolled up as high as the lower portion of bone, to prevent swelling from the constriction that has to be produced round the joint. A strip of bandage, about twelve or fourteen inches in length, is then to be placed on either side of the knee, near to the patella: two compresses are next to be applied, one being placed on the tendon of the rectus muscle, immediately above the upper portion of bone, and the other on the ligamentum patellæ, immediately below the lower portion. These two compresses are now to be fixed by carrying a bandage round them, and also including the lateral strips: the circular bandage should be firmly applied so as to press the compress down below the level of the portion of bone opposite to which it is placed. When the two compresses are so fixed, an assistant endeavours, by grasping the thigh, with one or both hands, to bring the upper portion of bone down as much as possible by *smoothing* the muscles down towards the knee. When this is done, the surgeon takes the two ends of either lateral strip of bandage and ties them together, so as to bring the compresses as close to one another as possible, and

so to fix them; by which means it will be seen that if the compresses grasp the bone well, the fractured portions will also be retained in their places, and their apposition preserved. The annexed wood-cut illustrates the application of the bandage.



Another plan of treatment, is that of applying a simple figure-of-8 bandage round the joint, so as to include the two portions of bone in one of the loops of the 8. This, however, cannot be recommended, for no purchase can be got upon the bone without making a degree of constriction that would be injurious to the joint, and render it necessary very soon to discontinue it.

Sir Astley Cooper and Mr. Amesbury both recommend the employment of leather straps to approximate the portions,—a circular one is carried above the bone, and two lateral ones, connected with it, are placed on each side of the leg. The principle of their treatment acts by making the strap that pulls the upper portion of bone down, pass to the foot. Sir Astley Cooper makes it go under the foot and up to the opposite side of the knee; while Mr. Amesbury connects it to a footboard, on which the foot rests: the strap, in either case, admits of being shortened as much as the descent of the upper portion of bone will allow of. Sir Astley makes no part of the apparatus fix the lower portion of the bone, but merely passes a bandage from the foot upwards to below the knee. Mr. Amesbury, by his contrivance, fixes the lower portion of bone also,

by means of a circular strap placed below it, and connected to that above the upper portion by two small lateral straps, which can be tightened at pleasure.

Mr. Amesbury's apparatus is more complicated than Sir Astley Cooper's; but appears to me to possess advantages which the latter author's does not. In the first place, it fixes the lower portion of bone as well as the upper, which I know to be very important from the experience I have had in treating this kind of fracture. In the second place, the straps Mr. Amesbury employs to pass circularly round the knee, are broad, and press chiefly on the upper surface of the limb, being connected to a splint that is passed behind the knee, and so are less likely to produce constriction round the joint; and thereby the force by which he pulls down the upper portion of bone tells more effectually, owing to its being fixed to a foot-board, instead of telling merely round the sole of the foot.

Dupuytren, Desault, and others, all recommend the treatment by bandages, gaining their purchase upon the two portions by means of the compresses, and circular bandages carried above and below the joint; the principle is much the same in all, though they differ in their particular mode of application. They are, however, according to my views unnecessarily complicated, especially Desault's.

All the above modes of treatment have a decided objection to them; namely, that they depend upon circular constriction of the limb, for the fixed point that is necessary for the lateral bandage or straps to act upon, by which the two portions of bone are to be approximated. The great evil of this is, that the apparatus cannot be applied until some time after the accident, often ten days or a fortnight, during which

period the muscles have been gradually contracting, either by the efforts of the patient or by their natural tone, until the portion of bone is so far drawn upwards, that in the majority of cases it is impossible to bring it into contact with the lower; so that no hope of gaining bony union can exist, presuming this to be possible under the most favorable circumstances. Every one must have seen in fractures of the patella, that in the majority of cases, if the patient be seen immediately after the injury, the two portions of bone can be brought into direct contact, and rubbed against one another; but that after four and twenty hours this cannot be done without some difficulty, and that at a later period it is impossible to do so at all. The rule of treatment then deducible from this fact is, that it would be desirable to fix the two portions of bone as soon as possible after the fracture, if not directly, and this certainly cannot be done by any of the above treatments, for they can none of them be applied until all the swelling and pain of the joint have subsided.

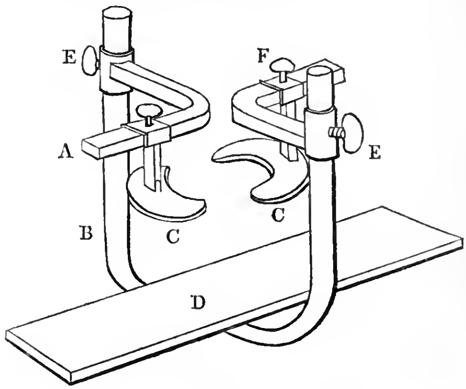
Another evil in the above modes of treatment is, that the nature of the materials employed is such, that whether it be bandages or leather straps, they will yield to a certain extent, however tightly they may at first be applied; and this is highly important to avoid in fractures of the patella, more than any other kind, as the only chance of gaining bony union, is by placing the two fractured surfaces in close contact, and if this cannot be done, it is as important that the new ligament formed should be as short as possible; the distance of a quarter of an inch added to that which already exists being sufficient to weaken the joint in a degree that may render the limb almost useless to the

patient. I should say, that it is next to impossible by means of either straps or bandages to prevent them yielding to the above extent, and often more; which, combined with the distance already existing, from the want of the original apposition of the two portions, is an important point to bear in mind in the treatment of this injury.

Considering the above points, namely, the importance of getting early approximation of the two portions, and of keeping them so approximated, by means that will not yield after they are once applied, induced me to invent an instrument that would obtain the above ends, and so do away with the objection to the ordinary treatment by bandages or straps.

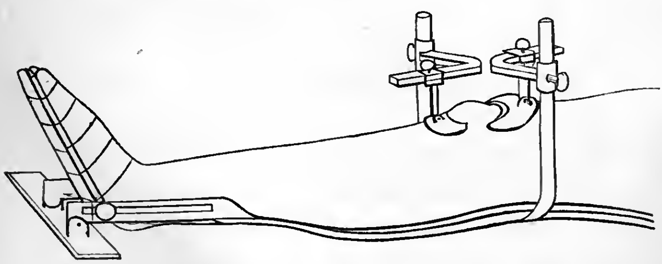
The first of these points, namely, the early approximation of the two portions of bone, can only be obtained by some contrivance, that shall fix the two portions without making circular constriction upon the joint; for any apparatus that constricts the joint, cannot be applied while the swelling and inflammation are present. With this view, as well as with that of bringing the portions of bone into close contact, I had the following instrument made. It consists of two plates of metal, shaped something like a horse shoe, so as to grasp the upper and lower portions of bone; they are also slightly concave underneath, to fit the shape of the limb on which they press. These two plates are marked C C in the wood-cut; the one that grasps the upper portion of bone being larger than the other. They are approximated to one another, so as to bring the fractured surfaces together, by means of a slide F; which moves upon another bar, backwards or forwards as may be required, so that any degree of approximation can be obtained by them, at the same

time that they only press upon the upper surface of the joint and produce no circular constriction. The vertical pressure by which the horse-shoe plates gain their hold upon the edge of the bone, is made by means of a sliding bar A, which is bent at right angles in the middle, so as to bring the part on which they play in the median line over the joint, and this is connected with a vertical rod B, placed on either side of the knee and fastened to a back splint D. The horizontal bars slide up and down upon them and are fixed at any height, by means of a screw E, so that any degree of pressure can be made upon the upper surface of the limb. The space between the two vertical rods is wide enough for the knee to fit into, without coming in contact with it.



The back splint to which the above apparatus is attached, should be long enough to extend down to the heel, at the bottom of which a sliding foot-board is attached, to admit of the instrument being adapted to limbs of various lengths, and to support the foot. It is applied as follows :—The horse-shoe plates, and the horizontal bars are to be first turned round, to admit of the knee and leg being placed on the back

splint, seeing that the vertical rods, B, correspond with the centre of the joint, and that the foot rests evenly on the foot-board. The foot and leg are then to be fastened to it, by means of a bandage carried upwards to near the knee joint, by which the back splint will be firmly steadied to the limb. The two portions of bone are next to be brought into apposition, and the upper one should be fixed first, by pulling it down as much as possible, and then placing the horizontal plate C, at its upper edge, seeing that it presses on the tendon of the rectus muscle, and not upon the bone itself; and when the upper portion is firmly pressed and brought down as low as circumstances admit of, it is to be fixed by turning the screw F; after which, the vertical pressure is to be secured by turning the screw E. The same thing is then to be done with the lower portion of bone, by adapting the other horse-shoe to it, in the same manner, and fixing it with the screw E of the opposite side. The two horse-shoe plates are attached by a hinge to the bar that moves them, to allow of their being more closely adapted to the different levels of the limb to which they are applied. The wood-cut represents the instrument complete, with the back splint and foot-board.



The two portions of bone are now fixed; for the upper portion cannot be pulled upwards, nor the lower

one moved downwards. It will be seen, then, that the above instrument gains the following ends, namely, that it fixes the two portions by means of a firm resisting substance, and so is little liable to yield from the position it is at first placed in. And at the same time that it fixes the bone, it does so by pressing upon the upper surface of the limb only, and leaves the rest of the joint free and unconstrained.

The following advantages appear to me to be derived from the employment of the above instrument. In the first place, the pressure being confined to the tendon of the quadriceps muscle, and to the ligamentum patellæ only (which it is, for the two plates press on these parts alone), allows the instrument to be applied at a very early period, and in many cases it might be immediately after the injury; for there is not now the same obstacle that exists in the ordinary treatment, namely, the circular constriction; which will of course preclude the application of any pressure when swelling exists, or is likely to come on: but now the whole of the joint is free and unconstrained, so that neither is the swelling that may be expected to arise in this kind of injury prevented, nor is the circulation obstructed; both of which are great evils, and are produced by the ordinary treatment of bandages and straps.

The above circumstances, then, give every chance of the direct approximation of the two portions of bone being produced; and, if so, of bony union: but, even if bony union cannot be hoped for, the next important object to have in view, is to cause the ligament, by which the two portions of bone must then be united, to be as short as possible; for the shorter the ligament is, the stronger the joint will be, and the more useful

the limb to the patient; and I am convinced that, although, as yet, I have not gained the direct apposition of the two portions, at an early period enough to expect bony union, that the ligamentous union has been rendered more favorable for the future use of the joint, than it would have been had the ordinary treatment been employed.

The first case in which I employed the instrument (and it then consisted of only one plate, to fix the upper portion of bone alone),* the ordinary treatment could not be borne; for the least circular pressure on the joint caused great pain to the patient, and swelling, so that it became necessary to discontinue it at two or three different periods; the consequence of which was, that at the end of a month the two portions of bone were more than two inches apart. I applied my instrument to the above case; and although, from the length of time that had elapsed from the period of the fracture, the direct contact could not be expected, nor bony union either; the portions of bone were brought so near, that little more than half an inch existed between them—the original distance being more than two inches. I have since had opportunities of employing the instrument in many cases, and have in all produced a much shorter ligamentous union than is done in the *majority* of cases by the common treatment. I have not, however, had an opportunity of applying it immediately after the fracture, which is the only time that offers a chance of getting actual contact between the fractured surfaces: for the retraction that takes place by the muscles, and the effusion that comes on within the joint, totally preclude the possibility of doing so if it be delayed to

* Vide London Medical Gazette, vol. XVII. p. 83.

a later period. I have no doubt, that were it applied, it could be borne from the very first, owing to so large a portion of the joint being free and unconstrained, and then every chance would be given for the production of bony union. The instrument should be kept on for two months at least, the better to ensure the strength of the ligamentous union, or of the bony, if it be inclined to take place.

Other kinds of splints have also been invented, than those which I have already mentioned. Mr. Mogridge has invented an instrument which consists partly of metal, and partly of straps: there are two pieces of metal, curved so as to grasp the knee vertically, and not horizontally as in the above instrument I have recommended. To either ends of these curved bars a strap is fastened, which passes down to the under part of the knee, and is then connected to a splint which is placed behind the joint. One of these bars is placed above the upper portion of bone, and the other below the lower, and the pressure is got by means of the straps that are fastened to the back splint. The approximation of them is gained by means of a screw, which passes from the upper part of one rod to the other, over the knee joint in its long diameter; by turning which, the two curved bars, which grasp the portions of bone, can be brought close to one another at pleasure and fixed there.

I should make the following objections to this instrument. In the first place, there is still the circular constriction necessary before a fixed point can be gained, to enable the approximating force to act upon the portions of bone, so that this is as great an evil as in the old treatment by bandages. 2ndly, The bars that press upon the limb are so narrow that they have

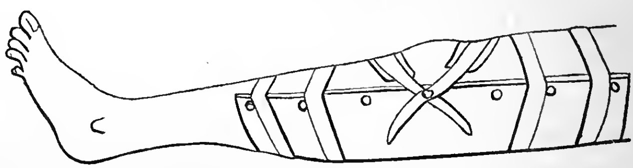
not sufficient purchase, without causing pain and inconvenience to the patient, from the degree of pressure it is necessary to make. 3rdly, The pieces of metal being connected to straps only, will not slide when the screw is turned, but be inclined to tilt upon their edges, and so cause the pressure to be unequal and insecure. Had Mr. Mogridge made his instrument of two hoops of metal, and to slide upon the back splint, so as to gain their approximation, instead of by the above screws, it would not then be so objectionable; for the hoops would have taken off the pressure on the joint, laterally, and the vertical pressure might be gained by having a slide at the side of the hoop, capable of being fixed by a screw at any height that might be necessary.*

There are two other kinds of treatment that have been recommended for this kind of fracture; the object of which is the same as in my instrument, namely, to do away with the circular constriction of the joint: the one was employed by Boyer—the other has been lately described in the Lancet, in the volume for 1836.

Boyer's instrument is the following:—it consists of a trough of wood, made wide enough to place the leg in, and to prevent pressure on the side of the joint; there are buttons placed along the sides of it, to fasten straps or bandages to, so as to secure and steady the limb to the splint. One of the buttons is placed opposite the centre of the knee joint, to which are attached two other straps; the object of which is to fix the two portions of bone; the one being made to press

* Mr. Amesbury, in his work on Fractures, gives a drawing of Mr. Mogridge's splint, which I have only seen since writing the above.

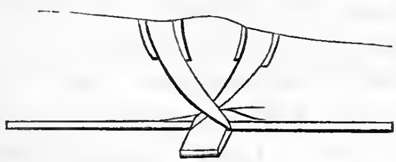
upon the upper portion, and then brought down to the button; the other, fixing the lower portion, being brought up to the same button; there having been a compress placed under each strap first of all. The wood-cut represents it.



The objections I should make to this splint are—that there being no foot-board, the apparatus is liable to shift its position, and then the straps on which the approximation of the portions of bone depends, will be displaced also. Another objection is, that although these straps do not make circular constriction, they are made of materials which must yield to a certain extent; and the line of direction in which the force acts is not the most favorable to make firm pressure, or keep the bone in close contact, and that they cannot grasp the small portions of bone, like those of a fractured patella, so well as when metal is employed for the purpose.

The other kind of treatment which has been recommended in the volume of the Lancet referred to, acts much on the same principle as that of Boyer; but instead of the trough that Boyer employs for the limb to rest in, a broad back splint is used, which passes above and below the knee joint, with two lateral bars standing out like a cross; the portions of bone are fixed by means of bandages, passed first round one lateral peg, then across the knee, round the other peg and back again to the same side, so as to include the upper

portion of bone only; but the lower portion might be equally well fixed (which the author of the above splint does not recommend), by passing the same bandage round the lower portion of bone, and then round the pegs in the same manner, as represented in the wood-cut.



The principle is the same as the treatment of the common figure-of-8 bandage, without the splint. The splint, however, gives it the advantage of not constricting the joint in the same manner. The objections to this kind of treatment are greater than to Boyer's; for bandages must be employed instead of straps, which yield more and do not press so evenly: the simple back splint does not give the bandage so great a purchase, nor steady the limb so much as Boyer's trough. Another fault of this treatment, however, is that the purchase on the two portions of bone is not sufficiently firm, while the joint is more constricted. The pressure also which is required to fix the bone being so very great, owing to the yielding substance of which the bandage is made, inconveniences the patient a good deal.

In employing any of the above instruments, however, something else has to be considered, namely, the period at which they ought first to be applied. With regard to the treatment by the circular bandage or straps, no doubt can exist as to the propriety of waiting till the swelling and pain have subsided; for the nature of this kind of treatment is such that it will

only increase these symptoms, and render it necessary to discontinue it shortly after its application ; and this I have stated to be one of the first objections to them, for much valuable time is lost, that might be producing the ligamentous union, were the fractured portions in close contact. It will generally be found necessary to wait ten days or a fortnight, and often longer, before any pressure can be borne by the constriction made circularly round the joint. By Boyer's apparatus, the pressure tells more on the upper surface of the limb, but then it tells unfavorably with regard to the approximation of the two portions of bone.

By the apparatus that I have recommended, the approximation can be effected at a much earlier period, for the reasons already given, namely, that so small a portion of the joint is pressed upon, that any swelling that arises hereafter, produces little or no inconvenience. I should have no hesitation to apply the instrument immediately after the fracture was produced, and this is the only way to hope to get bony union in these cases.—I remember one case in particular, where the patella was fractured above the middle, so as to leave a very small piece connected with the quadriceps, which admitted of being easily brought into contact with the lower. I saw the patient a very short time after the accident, before any swelling came on, and found the above facility of approximating the two portions of bone ; I accordingly expressed a wish to the surgeon under whose care the patient was, to apply my instrument at this early period, while the bone admitted of this favorable reduction, and when, I am convinced, I could have kept them in direct contact. The surgeon, however, was fearful of the swelling being constrained, and expressed a desire to wait till it

had subsided. The consequence of which was, that the upper portion of bone became, in two or three days, retracted to an extent of nearly two inches ; and a period elapsed of near a fortnight before the instrument could be applied ; and when I did apply it, I found that the contracted state of the extensor muscles was such, that with all the relaxation and endeavours to overcome it, the upper portion of bone could not be brought within three quarters of an inch of the lower, at the same time that it was so small that it sunk below the level of the lower, owing to the position it had been drawn into. Still, however, I am convinced, from the small size of this upper portion, that the treatment of bandages or straps would have been of no use ; for there was so little prominence that it was with great difficulty I could get the metal plate to hold it.

The other local treatment, besides the mere mechanical apparatus, consists in the application of cold lotions and leeches ; the latter are not generally necessary in the fracture by the muscles, for the nature of the swelling that comes on is not now so much inflammatory as it is when the injury has been caused by the direct force ; for then the soft parts are bruised at the same time, and inflammation to a great extent almost always takes place : in these cases it will also be necessary to have recourse to poultices and fomentations. Cold lotions are sufficient for the generality of cases, when there is simply the swelling of effusion of serum, and the colder the better,—I should recommend ice, when it can be obtained.

When the fracture is comminuted, or when it takes the vertical direction, little or no mechanical force is required to keep the portions of bone in contact ; for

in the comminuted, there not only is but trifling separation, but the inflammatory action that necessarily arises, produces a thickening and consolidation of the soft parts round the fractured portions, that no external pressure is required. In the vertical fracture also, the separation is little or none, and is easily remedied by the application of circular strips of plaster, with a small compress of lint placed on either side of the bone, so as to support it laterally. Perfect rest and the extended position of the joint, must of course be observed as in the other cases.

The remaining point to be considered with regard to the treatment of this kind of fracture, is one by no means the least important, I mean the time that it is necessary to confine the patient to his bed. This point also includes other questions, namely, the possibility of bony union being produced, and the mode in which it takes place if it be produced; so that I shall consider them together under the head of Prognosis of Fractures of the Patella. One thing every surgeon of any experience must be aware of, is, that few are the cases in which bony union is produced, if it can be at all; for in almost all, the union is so far from being ossific, that no doubt can exist as to the difficulty of producing it, and of the frequency of the ligamentous, which renders the patient lame for life, from the little power he has of extending the joint.

Another evil of the ligamentous union is, that it is liable to stretch after the patient has been using the limb for some time; this I should say is one of the greatest evils, for if the ligament would remain of the length it is often made during the time the patient is under treatment, the joint might then be rendered comparatively useful, and the fracture of this bone would not be looked on as of so unfavorable a nature

as it now is. Many cases I have seen where the two portions of bone have been so nearly approximated, as to leave a space of only half an inch between them, and could the ligament be preserved of this length, the absence of bony union would not be so much regretted; but I fear that it cannot, and that it is not in the nature of the substance of which this ligamentous union is formed, to resist the powerful action of the extensor muscles that takes place when the patient gets a little confidence in the use of his limb. I think I may say, that in all the cases of fracture of the patella, that I have had opportunities of seeing some months after what has been called their cure, the separation has increased, owing to the stretching of the ligament; and the joint has consequently become weaker, and the patient's gait more insecure. One case in particular I remember, where I had employed my instrument, and got an approximation so as to leave less than half an inch between the two portions of bone, and in which I also kept the patient three weeks longer than the usual period before he was allowed to get up. I began to think that although I had not produced bony union, that I had got so short a ligament, that the patient would not feel any very great inconvenience when he came to use the limb. I saw the man, however, three months afterwards, and was much disappointed to find the portions of bone nearly two inches apart; the ligament having stretched as soon as the muscles began to get a little freer play, by which the joint was rendered weaker, and the limb useless for any active exertion.

It may be asked, are there no means of preventing this elongation of the ligament? either by fixing the bone when the patient begins to use the limb, or by

confining the patient a sufficient length of time, to make it strong enough to resist the action of the extensor muscles. To the first of these questions I should answer decidedly, yes; but then any apparatus that was invented, and many might be, must be connected to a back splint, to be of any use, which must be firm and unresisting; so that all that would be gained by it, would be the production of a stiff joint, and no progress would be made towards regaining the use of the limb. Any kind of apparatus with a hinge to it, would of course be of no avail, for then the ligament would be liable to yield in the same manner as if no splint was there, and a consequent stretching of the ligament would be produced. The best after-treatment, as it may be termed, for fracture of the patella, is to keep a strong splint behind the knee when the patient is first allowed to get up, and he should wear it at least three weeks or a month. This not only prevents the flexion of the joint, and with it the separation of the two portions of bone, but it also prevents the necessity of the extensor muscles acting to any great extent, as the joint never has to be brought from the state of flexion, being kept in the extended position. With this precaution of the back splint, an additional support should be given, by strapping the knee joint firmly round with soap or any strong adhesive plaster, so as to include the two portions of bone within it.

In considering the second point, namely, as to whether the patient might not be confined a sufficient length of time to ensure the requisite strength of the ligament, for the future use of the joint; I cannot answer from my own experience with any satisfaction, for though latterly in the cases that I have seen treated,

the patients have remained in the horizontal position for about twice the usual period, yet still in those which I have had an opportunity of seeing afterwards, the ligament has yielded to a certain extent, so as to render the joint much weaker than it would have been, had it remained of the length it was when first formed. It may be asked then, would the same stretching of the ligament take place, supposing the patient were not allowed to get up before the expiration of a much longer period than that usually employed; for instance, if he were kept in the horizontal position for six months, or twelve months, would the ligament then be strong enough to support the joint without yielding? Six months, or twelve months, no doubt is a very long period to confine a patient in the horizontal position, who is otherwise in good health; but I am inclined to think, however tedious and inconvenient such treatment might be, that it is the only one that offers any chance of removing the evil of which I am now speaking.

As a general rule, I should say that after a fracture of the patella, the patient should be confined in the horizontal position for at least three months, and as much longer as he likes to submit to this position—for nothing will be lost by so doing, but advantage gained. When he gets up, he should wear a splint behind the knee for three more months, with the additional support of plaster and bandages. It may be said that this long confinement of the joint in the position of extension will be liable to produce stiffening, which will be difficult to remedy. To this I answer, that there is no fear of producing any degree of stiffening in the joint that time will not overcome; and that it is quite as well that there should be difficulty in moving

the joint when the splints are first discontinued; otherwise all the reparation that had been going on during the period of treatment, might be undone the first day on which the patient attempts to use the limb without the support of the back splint, by the knee bending to the extreme state of flexion from that of extension, by the joint suddenly giving under him.

Additional precautions should be given to the patient when he first begins to walk. He must of course use crutches, until he has had sufficient practice to enable him to walk with a stick only, when he may discontinue them. During this time he should wear a sling passed round the neck and under the foot, for the first few days, only putting the foot to the ground occasionally, till he finds he can bear his weight upon it. He should be cautioned particularly to place the foot flat, and not to walk on the toes, but rather on the heel; for if he press upon the toes more than the rest of the foot, there is a disposition to flex the knee, which cannot but do mischief at this early state of the union. He should also let the leg swing forwards when walking, rather than attempt to bring it before the other by the action of the muscles of the thigh.

The condition of the extensor muscles also deserves consideration in another point of view. It is stated by some authors, that the long confinement of the limb, and the shortened condition of the rectus muscle when much retraction has taken place, cause the muscle to lose almost all its power of action; or, at any rate, that it is a very long time before it regains it. Sir Astley Cooper says, "If passive motion were not used, it is to be apprehended that the action of the extensor muscles would never return: for those who

are kept long in bed, with the joint at rest, do not in many months acquire any power of bending and extending the limb." I cannot say that I agree with this statement altogether; for I believe that the joint itself is one of the chief parts that opposes the free motion at first, and not the muscles: for we find that not only the patient himself cannot use the joint, but that it is difficult to give any great degree of passive movement to it, which would not be the case were the muscles alone in fault. Besides, it is not only the extensors that are powerless, for the patient has equally as great difficulty in flexing the joint, at first, as he has of extending it; and yet no shortening or retraction of the flexor muscles takes place.

The remaining point to be considered with regard to this kind of fracture, is, whether it can unite by bone, or whether its union is always ligamentous; and, if the latter, upon what does the peculiarity depend?—and are the causes the same as those which influence the union of fractures of the neck of the femur? These points I shall next consider.

It appears to me that we must bear in mind the following points, and reason in the same manner as when speaking of fracture of the neck of the femur, if we wish to arrive at the true explanation of the process of union in this bone; and then to compare the two, and see where they differ. In the first place, then, we must divide the fractures into those which occur transversely, and into those which are vertical; and, secondly, into those which are comminuted. Now, experience has decided that the transverse fracture unites so rarely by bone, that, even in the present day, there are fair grounds for disputing its occurrence at all—while, on the other hand, there are cases mentioned in

which the vertical fracture has united by bone; and there are many preparations illustrative of the same point. The comminuted fracture has also been found to join by ossific union as well. Such being the facts established with regard to the manner in which this fracture generally unites, we have to see upon what this great difference in the two kinds of cases depends, namely, to see why the transverse fracture seldom, if ever, has bony union; while the vertical and comminuted unite comparatively very often in this manner.

The first important point to be decided is, whether the patella, when fractured, can, under any circumstances, unite by bone; and, if so, what are these circumstances?—and in what do they differ from those under which the portions of bone are placed when the ligamentous union only is produced? As already stated, there are preparations which exhibit the formation of bony union in the vertical and in the comminuted fractures, so that these are sufficient to prove that such union can take place, and that the relation of the bone with the knee joint has nothing peculiar in it to prevent this process going on here, as in other fractures. Now the peculiarity of the vertical and of the comminuted fracture is, that no separation of any importance takes place, and that no difficulty of keeping the fractured surfaces in contact exists. While, on the other hand, with regard to the transverse fracture, neither of the above circumstances are present, but the bone is retracted to a great extent; and, as a general rule, it is impossible to bring the fractured surfaces into contact. Are we then to consider this separation of the fractured portions, and the want of direct contact as a sufficient explanation for the bony union not taking place in the transverse fracture? I should say,

without hesitation, that this is one of the chief and the most important causes of the ligamentous union being produced instead of the bony; for the circumstances of the two portions of bone are, in the main points, the same as in the vertical fracture; the only difference being that its direction is transverse instead of perpendicular; and if the vertical can unite when the fractured surfaces are in contact, why should not the transverse, were it capable of the same approximation? From some experiments made by Sir Astley Cooper, it appears that the vertical fracture also unites by ligament, when there is any degree of separation of the two surfaces, and that it requires the actual contact to produce the bony union. I remember seeing a case after death of a vertical fracture, in which however there could not be said to be any separation, and still the union was only ligamentous. The fracture was taken from a subject in the dissecting-room, and was only discovered accidentally on opening the knee joint. There was found to be a deep fissure, extending perpendicularly along the inner surface of the bone, in the part that rests against the outer condyle; this portion was found to be quite moveable, but was not at all displaced. On stripping off the skin and tendinous fibres that cover the anterior surface of the bone, no callus or any indication of the fracture could be discovered—so close were the two portions in contact. After maceration, however, the line of separation could be seen. The approximation was highly favorable to bony union, and yet none had taken place. No history of the above case could be got, but from the appearance of the bone, there could be no doubt about its having been fractured, and a long time before death; for the joint and adjacent parts did not present

the least appearance of diseased action, but looked natural and healthy.

The next point to be considered is, whether the situation of the bone, in forming part of the joint, has anything to do with retarding the ossific process; and, if so, what is the analogy between it and the neck of the thigh bone. I think these points are soon answered. In the first place, if it is found that bony union can take place, and of which we have proofs in the vertical fracture, it is quite clear that the situation of the bone has no power of preventing it; and that there must be other circumstances that retard the process, when such union is not produced, and nothing peculiar in the bone itself. In the second place, there is no analogy between this kind of fracture and that of the neck of the thigh bone, within the capsule; for here the fractured portions are not within a capsule, but communicate freely on the external surface with the cellular tissue and skin around it; and that these external soft parts have the power of forming the callus, is proved by the union of the vertical fracture. It may be said that here there is no muscle injured; or the same degree of effusion and subsequent action round the bone, after the fracture of the patella, as there is in other kinds of fracture, and that this may be a reason for the bony union not being produced; but this is not only proved to be an insufficient reason by the ossific union of the vertical fracture occurring, but by taking some other kinds of fracture, where there is no muscle or effusion round the ends of the bone:—for example, simple fracture of the phalanges of the fingers unite by bone easily enough; and there is generally little or no mischief done to the soft parts

around, and there is no muscle to tear, or to cause effusion round the fractured ends.

From the above circumstances then, I should be inclined to draw the conclusion, that the true cause of ligamentous union being produced instead of the ossific in fractures of the patella, is the absence of contact of the two fractured surfaces; and that could the direct contact of the two portions of bone be got immediately after the fracture, and be preserved, the bony union would then take place in the transverse as well as in the perpendicular fracture; and that the only peculiarity of this fracture is, the great difficulty that exists in preserving the direct apposition of the two portions of bone, which difficulty is so great, that we are justified in saying that transverse fracture of the patella never does unite by bone; but at the same time, we are not justified on that account in asserting that it never can do so.

FRACTURES OF THE LEG.

Before considering the symptoms of fractures of the bones of the leg, we should look to their shape, and to the kinds of force that are liable to act upon them; we shall then be able to understand many of the peculiarities that exist with regard to the parts of the bone that are most liable to yield, and with regard to the particular direction the fracture is most likely to take.

The two bones of the leg are quite different both in shape and office; the tibia is large and strong, and destined to support the weight of the body, while the fibula is small and weak, and takes no part in bearing the superincumbent weight; the use of the fibula being only to strengthen the ankle joint, and to give attachment to the muscles of the leg that are necessary to move the foot and toes. The shape of the two bones is so different, that at once it must be seen that different forces will act upon them, and that the fracture will take different directions. The tibia is not only capable of resisting a powerful force, from its peculiar shape, the greater length of its shaft being triangular, but its internal structure is compact and dense, and so gives it additional strength, and renders it less liable to yield than it otherwise would be. The fibula, on the other hand, having no weight to support, is made slight and thin; its structure is also loose and cancellated, and consequently easily broken when placed under the influence of any force. The connection of

the two bones differs as much as their shape and structure, for the tibia is connected directly at both extremities, by broad articulating surfaces, which rest horizontally against two corresponding surfaces of the adjoining bones, the head of the tibia receiving the two large condyles of the femur, and the lower extremity of it, the astragalus; they are each connected by means of strong ligaments and kept in close contact, so that any force coming from above through the femur, or coming from below through the foot, must tell at the same time upon the tibia. On the other hand, the fibula does not rest in the same firm manner against its articulating surfaces; but is, at its upper end, joined to a small tubercle on the outer side of the head of the tibia, the joint having no strength to bear any weight, while the lower end presents a lateral face which fits into a corresponding articular surface in the tibia and astragalus, which joint also has no power of bearing any weight upon it. Notwithstanding this weakness of the articulation of the fibula, it is found seldom dislocated; and the reason is obvious, namely, that the shaft of the bone is so small and weak, that a force breaks it before it can tell upon the extremities of the bone, so as never to allow it to have any influence upon the articulating surfaces, for the force is destroyed before it reaches them. It is important also to consider the motion of the tibia with regard to the knee and ankle joints, for the direction and power of the force will tell according to the line it takes as regards them; thus, supposing a force to be so applied that it is disposed to act upon the shaft of the tibia from before backwards; and again, suppose another force to act so as to tell from without inwards: in the latter case, very likely the bone would break, while in

the former it would not; and the reason of this is obvious, when the motion of the two joints with which the tibia is connected are considered. In the former case, the force would tell in a direction that would act upon the joints as well, and so cause them to yield and diminish the force; while in the latter case, the force would be acting sideways, in which direction the joint does not move, and consequently no yielding of them would exist, and no diminution of the force, which would then all tell upon the tibia.

The tibia and fibula are more frequently fractured than any of the other bones of the lower extremity; this may be accounted for by their situation exposing them more frequently to injury, and by their position being such, that the superincumbent weight of the body tells more directly upon them than it does upon the femur; for a person may fall and have the leg placed in many situations that will enable a force to tell upon these bones, that will have little or no influence upon the femur.

The bones of the leg are less protected by muscles than the thigh bone, for the anterior and inner surface of the tibia is merely covered by integument, throughout its whole length; this circumstance combined with the anterior acute margin of the bone, causes compound fractures to be much more frequent here than in the thigh; still, however, it does not occur so frequently as might be expected, when this circumstance of the sharp margin of bone, and the thin covering of integument only that lies upon it are considered, for then we should expect that fracture could hardly ever take place without the end of the bone being driven through the skin. The comparative rareness of the compound fracture of the leg may be

accounted for, by supposing that the kind of force that produces it, seldom acts in a direction that tells towards the integument after it has produced the fracture. Thus it will be found that, in the majority of cases, the lower portion of bone is almost always drawn behind the upper, it may be to the inner or the outer side as well, but it is almost always behind at the same time ; another displacement also occurs, namely, retraction of the lower portion before the upper. With the former position of the lower portion of bone we have to observe two things ; the one is, that the most moveable end of the bone (which would be the likely one to penetrate the skin) takes a direction from the integument, while the retraction that takes place at the same time also relaxes the skin, and so renders the upper portion little likely to wound it, as it requires the skin to be tense, before a substance like the end of a bone can pass through it. I believe that the majority of cases of compound fracture, which depend upon the end of the bone inflicting the wound, will be found to be owing to the fracture taking a direction very oblique, and downwards and inwards, for the end of the bone is then brought directly in contact with the skin, and may perforate it, by the force acting upon it after it has caused the fracture.

The bones of the leg, like those of the fore arm, may be fractured both together or singly ; but there is a difference in the frequency of the kinds of fracture, for while both bones of the fore arm are fractured less frequently, it is found that both bones of the leg are fractured more frequently, and that the tibia and fibula singly, are not so often broken as either the radius or the ulna. This is easily explained, by considering the difference of the shape and mode of articulation of the

two bones, and the influence of the different kinds of force that act upon them.

The reason why the tibia and fibula are more frequently broken than either bone singly, is, that a force sufficient to fracture the tibia, is generally sufficient to extend to the fibula afterwards, and so to break it; while, on the other hand, it must be a peculiar kind of force to break either the tibia or fibula singly, which I shall consider when speaking of these fractures alone.

The force that fractures the bones of the leg, may, like in other fractures, be divided into two kinds; namely, the direct and the indirect; and these two different forces act differently upon different parts of the bone; thus there are some parts of the tibia, namely, its head and lower extremity that can never be brought under the influence of the indirect force, but must always be fractured by the force telling directly upon it, in some one direction or another, and causing it to break at the point struck. While on the other hand, the shaft of the bone may be broken by the indirect force, as well as by the direct; for its length makes a force to tell upon it which has first passed through either the upper or lower end, as when a person falls with the leg obliquely under him, the lower end of the bone will be fixed by means of the foot upon the ground, and the upper end will be fixed to the femur by means of the ligaments of the knee; these two points are capable of resisting the force, owing to the weight of the body, and it then extends to the shaft of the bone, and may cause it to break without any external violence being directly applied to the part that yields. Or again, it may be broken by the direct force, as when a heavy weight falls upon some part of the shaft of the bone, and causes it to

break at the point struck. The fibula may be broken either by the direct, or by the indirect force; the former occurs when the blow or weight comes upon the bone and snaps it, the latter kind acts when the force tells through the ankle joint, by the foot being so placed as to press upwards against the lower end of the bone, by which the weight of the body tells upon the fibula as well as on the tibia, but in a direction to stretch or rupture the internal lateral ligament instead of fracturing the tibia; this occurs in what is called Pott's fracture of which I shall speak presently.

The nature of the force that acts to cause the fracture of the leg, of course varies here as it does in other fractures; the most frequent kind, however, is by the patient slipping, or falling, or jumping. All these forces act indirectly; that is to say, the person comes to the ground on his feet, but the leg is placed in such a position that the weight of the body, which is increased by the fall, tells obliquely through the limb, and so causes the stress or force to come on some part of the shaft, instead of passing vertically upwards through the long diameter of the bone. The force at the same time gains a lever power, owing to the length of the shaft of the tibia, which enables it to snap the bone across.

The direct force may be almost of any nature, for any weight or force that is applied to a part of the limb, will, if sufficiently powerful, break the bone, provided its two extremities are fixed so as to enable it to act. The most common example of the direct force acting upon the bones of the leg, is a wheel passing over the limb, or by the part being jammed between two forces—as a weight falling upon the leg while it is on the ground or resting on any other resisting sub-

stance. It is not necessary, however, that the direct force should have an external resisting body on the opposite side of the limb before it can act; for the leg may be so placed that its two extremities are fixed by means of the knee and foot, and then a force applied against the bones, near their centre, may break them across. An example of this may be given, by supposing a person to be standing upright with the foot flat upon the ground, and that a weight is thrown against the limb, so as to strike it on the outside, near the centre; if the force act sufficiently, the bones may yield at the point struck, and this may take place before the person falls to the ground; or, in other words, before a resisting force acts from the opposite side of the limb. There is a resisting force of course gained by the two ends of the bone being fixed, but the accident would in this case be of a less severe nature than if the fracture were caused by the limb being jammed between two forces.

Fractures of the bones of the leg admit of being divided into three kinds; and their symptoms and treatment may be considered separately under these distinct heads. First, There may be fracture of both tibia and fibula at the same time. 2ndly, There may be fracture of the tibia singly. And, 3rdly, Fracture of the fibula singly. I shall consider them in the above order, describing the symptoms and treatment of each particular kind.

FRACTURE OF BOTH BONES OF THE LEG.

The tibia and fibula may be both fractured at once, and, as already stated, by two different kinds of forces, namely, the direct and the indirect. By the former

kind, the bone breaks opposite the part struck; by the latter kind, the force may be applied to one part, and the bone may yield at another, remote from it. This difference in the kind of force that produces the fracture, also causes another peculiarity; which is, that when the direct force acts, the two bones are generally, though not invariably, broken opposite the same point; while, when the indirect force acts, the tibia may be broken at one point, and the fibula at two or three inches from it. Attention to this point may assist in forming a correct notion of the nature of the force that caused the fracture, though of course it cannot be depended upon as a certain indication, for particular circumstances may allow of the indirect force breaking the two in the same line, and others may occur which cause the direct force to break them at two different points. The explanation of the two kinds of force acting differently, is easily understood; for when the difference in size, shape, and strength of the tibia and fibula is considered, it is not to be expected that they can both offer the same resistance; the consequence of which is, when the indirect force acts, it tells obliquely on the limb, and first of all fractures the tibia—suppose near its centre; after which it comes upon the fibula, which bone not only is not of the same strength, but the force acts in a different line, by the limb becoming more oblique after the tibia has yielded, so that not only does the difference in shape and strength of the bone cause its point of resistance to be differently placed to that of the tibia, but the line of direction of the force is altered at the same time, which two circumstances cause it to break at a part remote from the point at which the tibia yields. The direct force acts under different circumstances; for provided

the force applied have sufficient power, this difference in strength of the two bones is of no value, for it causes the one to yield as easily as the other, and breaks through their substance immediately at the point struck, as it tells in a line directly through the limb, and not obliquely, as when the indirect force acts. The situation of the fracture of the bones varies more when the direct force causes it than when the indirect does, for the direct force will break it at whatever part it is applied, and this may be at any point from the head of the bone down to the malleolus. But the indirect force, from the peculiar manner in which it acts, renders the situation of the fracture much more regular; for, as already stated, the limb must be placed in a certain position before it is brought under the influence of this kind of force; which position is not much varied, nor is the direction of the force much altered either. It is accordingly found that fractures of the leg, by the indirect force, generally occur within the lower two-thirds of the bone, and very seldom in the upper third; for this upper third is not only the thickest and strongest part, but it is also too high to come within the line of action of the indirect force. The lowest two inches of the bone also are seldom under the influence of the indirect force, and are therefore seldom fractured by it: a violent and sudden twist of the ankle however, dependant on a fall, may cause fracture in this situation. The fibula, from its length and weakness, allows this kind of force to act much lower down than the tibia, so that fractures of this bone often occur near to the ankle.

When the upper third of the tibia, which includes the broad thick head of the bone, is fractured, the force must be of a very violent nature, and directly applied;

for not only does its shape and thickness give it strength, but its internal structure is cancellous, and not brittle as in the shaft of the bone; which circumstance renders it necessary that the force should be directly applied to it to cause its fracture, and be of a very powerful nature at the same time. The lower two inches of the bone also become more cancellous, and spread out to a broader shape, and although this part is also generally fractured by the direct force, it does sometimes happen that the indirect acts upon it under particular circumstances.

The position of the fracture in the fibula, when it occurs in conjunction with that of the tibia, also varies according to the kind of force that caused the injury. As a general rule, I think it will be found that it breaks at a point higher than that at which the tibia gives, when the indirect force acts. It is not uncommon to find the tibia broken near its centre, while the fibula is broken an inch or two higher up: but it is not often found that the fibula is broken below the point of fracture of the tibia. When the direct force acts, the fibula generally yields at the same place with the tibia, unless the force acts obliquely across the limb, as a wheel passing obliquely instead of directly across it, or any other weight striking the two bones at two different points.

The direction the fracture takes is generally oblique through the tibia, and this obliquity may extend various ways; thus it may be downwards and inwards, or downwards and outwards, with modifications of backwards and forwards. The cause of the fracture generally being so oblique in this bone, I believe to depend upon its shape; for, being triangular, the resistance the bone offers is various in different parts of its thickness, and will so alter the line of direction of

the force as it passes through it. It is very rare for the fracture to extend transversely; I have seen two or three cases, and they were all produced by the direct force.

The most common line for the obliquity of the fracture to take, I think I have observed to be downwards, inwards, and forwards; it is not unfrequently downwards and outwards towards the fibula, but generally forwards at the same time. By forwards I mean so as to allow of the upper portion overlapping the lower, by which the lower is generally retracted behind the upper, so that the projecting point of bone is produced by the fractured end of the upper portion, the fractured end of the lower being concealed behind it. It is by no means so common to find the fracture of the tibia extending downwards and backwards, so as to cause the fractured end of the lower portion of bone to project under the skin; and I believe, in the majority of cases, it takes the other direction, namely, downwards and forwards. The fracture may, and often does, take other directions than that of obliquely from one side to another: it may, as already stated, be transverse, though this is the rarest kind; but it sometimes takes a vertical direction in conjunction with the oblique; for the fracture may begin by being oblique, and extend in this direction through a part of the bone, and then alter its course and pass upwards or downwards, so as to split the bone in the line of its long diameter. The bone, in this kind, need not necessarily be separated quite through, for the fracture may stop and leave it still continuous in some part.

The tibia may be comminuted into two or more pieces at the point of fracture, but this is generally owing to the action of the direct force. The compact

and brittle structure of the shaft of the bone also favors this comminution, so that it is not uncommon to find it broken into numerous small pieces, when the force applied has been very violent.

The direction of the fracture of the fibula may be either transverse or oblique, and I believe it is as often the one as the other; for its structure is less brittle than the tibia, and its shape is such as not to alter the direction of the force. If any difference exist, I believe it will be found that the transverse occurs more frequently than the oblique.

The symptoms of fracture of both bones of the leg together, are generally sufficiently prominent to indicate the nature of the injury without the necessity of much examination; but it is not so when one bone only is the seat of the injury, for then the displacement and retraction of the portions of bone, which form so marked a symptom in fracture of both bones, may be absent altogether.

The displacement of the fractured portions of bone, and the retraction of one behind the other, varies in degree, and is dependant on the two last points that have just been considered, namely, the situation and direction of the fracture. I shall therefore consider the above symptoms according as the fracture is in one part of the bone or another, or as to the direction it may happen to take, whether it be oblique, or transverse, or comminuted.

In considering the displacement that occurs in fractures of the leg, it will be seen that the oblique fracture will be the one that allows it to take place in the greatest degree, owing to the difficulty there will be of keeping the ends of the bone in contact. The force that displaces the portions of bone is of

two kinds, thus it may be produced by the action of the muscles pulling the lower portion above the upper, or it may be produced by the force that causes the fracture, driving the one portion of bone from its contact with the other after it has broken it. I believe this latter kind of force to have as much, if not more, to do with the primary displacement of the fracture, than the former; for it is much more probable that the same force should go on acting after it has fractured the bones, than it should cease directly. Suppose a person to fall with the leg obliquely under him, and to fracture it by this kind of force, and that immediately after it had broken the bones, it was to continue acting; the lower portion would be driven in the same direction beyond the upper, quite independent of any muscular action. When once displaced, however, the muscles will act, and oppose the reduction of the fracture; or they may primarily act upon the lower portions of bone, as when the fractured ends are moved from their contact, supposing them to have been previously locked within one another, they may then displace the bone, independently of any further mechanical violence.

Whether it be previously as original causes of displacement, or as opponents only to the reduction of the fractured ends, that the muscles act, they are found to offer as much, if not more, resistance in fractures of the leg than in any other fracture; and this is easily explained, by considering the many powerful muscles that pass from one part of the leg to another, and act upon the two portions of bone; and that the fracture of the tibia is so often oblique, and the retraction thus favored by the difficulty there is in preserving the fractured ends in contact.

The chief muscles that cause the retraction of the limb, are the gastrocnemius and soleus; they are very powerful, and the disposition of their fibres admits of more shortening than the other smaller muscles that lie deeper; these smaller muscles will of course exert some influence on the lower portion of bone, by altering its angle with the upper, but they will not have much power of producing retraction. Retraction then, is one great feature of fracture of the leg, when the direction of the fracture is oblique. Retraction may also take place in the transverse and comminuted fractures; it cannot take place, however, in the transverse, without the force that produced it has extended to the lower portion of bone afterwards, and driven it from its contact with the upper; for when once the contact is destroyed, the muscles will of course act, as when the fracture is oblique originally. In the comminuted fracture, retraction generally takes place to a greater or less extent, for if the bones are broken into many portions, the separate pieces allow of displacement, and the lower portion is acted upon by the muscles, and brought nearer to the upper portion without the line of the lower and upper portions being much altered. The line of action then of the muscles of the leg, in whatever kind of fracture it is, is always the same; namely, upwards towards the knee. It is seldom that any angle is formed in fractures of the leg by the action of the muscles; there may be one formed by the position of the limb, causing the weight to tell unevenly on the two portions, of which, however, I shall speak presently.

The side of the limb on which the displacement occurs, depends on the line of obliquity the fracture takes, and on the direction in which the force tells.

Thus if the fracture extend downwards and inwards, and forwards at the same time, the lower portion of bone will be drawn upwards, backwards, and outwards; if it extend downwards and outwards, it will be drawn to the inside. If the fracture take a line downwards and backwards, the lower portion will then overlap the upper, and cause the displacement to be forwards instead of backwards, making the lower portion of the bone the prominent one. The direction of the force will also vary the line of the displacement; for when applied from the outside of the limb, it will be disposed to displace the portions of bone inwards, and when from the inside, in the opposite direction. I have merely mentioned these few words with regard to the line the fracture takes, to explain, as a general rule, the law that governs the displacement; but of course all these may be modified, both in kind and degree, according as the direction varies in obliquity, and as the force applied to cause the fracture varies in power.

The fibula, in fractures of both bones of the leg, seldom takes any part either in facilitating or in preventing the displacement; for the fractured ends of this bone present so small a surface that very little force destroys their apposition, when the tibia is broken at the same time.

When the fracture is situated very high up, near to or through the head of the tibia, which it may be when the direct force acts upon it, the displacement is little or none, unless the fracture be much comminuted; for in this situation the structure of the bone is cancellous, which causes it to break with a more irregular fracture, giving the surfaces a rough uneven shape, by which the ends of the bone are locked within

one another, and require a powerful force to displace them.

Fracture through either extremity of the tibia is always to be regarded as a very serious injury, and for many reasons; in the first place, the nature of the injury implies that a very powerful force has been employed to produce it, so that the structure of the bone may be expected to be more implicated, at the same time that the soft parts around are greatly bruised, and often produce more serious consequences than the fracture of the bone itself. 2ndly, Fracture through the head of the tibia, or through the lower extremity of it, is liable to take the vertical direction more than when it is situated in the shaft of the bone; a circumstance that always renders it doubtful whether the knee or ankle joints are not included, according to the extremity of the bone the fracture may be in; for it is not uncommon to find the fracture in these situations extending into the neighbouring joints, so complicating the injury, and diminishing the chance of the patient's recovery. 3rdly, Fracture through the extremities of the bone may be compound; in fact all the circumstances attendant upon it, render the injury one of a most serious nature, such as often to render amputation necessary, in order to save the patient's life.

Fracture through the lower end of the tibia may take place so as to split the bone upwards, by a fall from any height upon the sole of the foot, with the tibia in the vertical position. The inner malleolus is sometimes broken off, and accompanied by fracture of the fibula, about three inches above the ankle;—this takes place when the person falls with great violence, so as to twist the foot outwards, and bringing

the malleolus in forcible contact with the astragalus. This accident resembles Pott's fracture in appearance; the difference being, however, that the tibia is broken as well as the fibula; whereas in Pott's fracture, the fibula only is broken, and the end of the tibia displaced to a certain extent from its articulation with the astragalus.

The symptoms of these fractures through the extremities of the bones of the leg are by no means always easily discovered, and it is next to impossible to do so if the patient be not seen till swelling have come on round the bone. These accidents are always accompanied with more ecchymosis and swelling than fractures of the shaft of the bone, owing to the nature of the force that produces the injury, as well as the joint being more or less injured at the same time, which causes the effusion to be greater than it otherwise would be. If the patient be seen at an early period, before the swelling have come on, the fracture of the fibula may generally be discovered, but it is always difficult even then to ascertain the fracture of the tibia, owing to the absence of motion, and the consequent crepitus between the fractured portions. The fracture in the lower end of the tibia, however, is easier to discover than when through the upper end or head of the bone; for, by turning the foot in various directions, a crepitus may be got, and the motion of the fractured portions felt, when the fracture has separated the inner malleolus, or has extended transversely across the bone; but now it is often difficult to tell whether the crepitus be from the fibula only, or from the tibia as well. The transverse fracture of the lower end of the tibia is often attended with marked displacement of the foot and lower portions of bone, as is represented in the an-

nexed wood-cut, which was taken from a patient who was in the Middlesex Hospital in the year 1832. The tibia and fibula had been fractured twice about two inches above the ankle.

This kind of accident is easily distinguished from dislocation of the ankle joint, if any doubt should arise as to the nature of the injury; for it is only necessary to examine the relation of the lower end of the tibia and fibula to the astragalus and os calcis, and if the displacement be above the ends of these bones, it is sure to be fracture and not dislocation. As a general rule then, when the fracture extends upwards into the joint, little or no displacement occurs; while, in the transverse fracture, it may, although the fracture be only an inch or two from the joint.

I believe that in those fractures very near to thejoints—whether it be the knee or the ankle—the muscles have very little power over the ends of the bone, for the reason already given, namely, that the fracturedsurfaces are so broad, and often irregular, that the ends of the bone are locked within one another. The displacement in these cases arises from the force that produces the fracture continuing onwards to the separated portions of bone, and moving them in the direction in which the force was telling.

The crepitus is a symptom that is met with oftener in fractures of some parts of the leg than in others. When the fracture is in the shaft of the bones, it is easily produced, for then the motion of the portions of bone is

obtained by a very slight force; but not so with fractures through the extremities of the bones,—for though the fibula gives a crepitus, the tibia may not, owing to the difficulty of moving the fractured surfaces against one another. In the fracture of the shaft of the bones, it is not much wanted in the diagnosis, for when it can be got there are other symptoms sufficient to decide upon the nature of the injury without it; such as free motion of the fractured portions, with displacement of the ends of the bone. In fractures through or near to the joint, it is not of much use either; for without the portions of bone can be moved to any sensible extent, the crepitus may be caused by the fibula only, or by effusion into the sheaths of the tendons, or amongst the ligaments of the joint. This latter sensation, however, can easily be distinguished from the crepitus of a fracture, by one experienced in examining these kinds of injury.

The way to discover the crepitus, when the fracture is near to the ankle joint, is by placing the palm of the hand under the sole of the foot and grasping it firmly on either side, and then making attempts to move it forcibly in different directions; and the motions of abduction and adduction will be most likely to produce a crepitus, as the ends of the bone are more easily removed from their apposition by this means than by extending and flexing the joint. The difficulty however in these cases, as already stated, is, when no deformity opposite the fracture exists, to know whether the crepitus is derived from the fibula only, or whether it be produced by the tibia as well. As a general rule, however, in the transverse fracture of the tibia, just above the ankle, when accompanied by fracture of the fibula also, there will be found to be sufficient de-

formity present to decide upon this part of the bone being fractured, even if the crepitus obtained cannot be said for certain to depend upon this bone as well as the fibula. This deformity is completely diagnostic, when found to exist above the malleoli, for then it cannot be dislocation, otherwise the deformity would be below them, owing to the articular apposition of the bones forming the ankle joint being destroyed; whereas in fracture, the articular surfaces are in contact, and the displacement, if any, must take place above them. In those cases, however, where the fracture is not transverse through both bones, a crepitus may be produced distinctly in the fibula, while none can be got from the tibia; for the lower end of the tibia is often broken by a vertical fracture, which renders it difficult to move the fractured surfaces upon one another.

The same remarks are almost equally applicable to the fracture when situated at the upper extremity of the tibia and fibula, though here there is not so much chance of producing the crepitus, for it is next to impossible, without the fracture be very oblique or much comminuted, to get motion between the portions sufficient to produce it. Deformity also seldom exists in the fracture near to the knee joint, owing to the broad surface of the portions of the bone, and to the little power of the muscles over the fractured ends in this situation.

When fracture is situated in any part of the shaft of the bones of the leg, the crepitus is easily produced, owing to the mobility that exists between the fractured portions. When the fracture exists in the tibia only, the same facility does not always exist, for the fibula then serves as a splint to a certain extent, and keeps the fractured ends of the tibia in apposition. These

remarks, however, apply more to the fracture transversely across than when it extends obliquely through the shaft of the bone; for then a crepitus can generally be got, although the tibia only be fractured.

The consideration of the production of the crepitus in fractures of both bones of the leg, also comprises another symptom, namely, the mobility of the fractured portions. It does not follow, however, that because a crepitus cannot be produced without the portions of bone are made to move upon one another, that motion cannot take place without the crepitus; for it often happens that free motion can be given to the fractured portions without any crepitus at all being produced: and the fracture may take such a direction that no grating or rubbing of the surfaces is allowed, although it admits of their being separated from one another to a great extent, and then of being replaced, so as to indicate distinctly that a solution of continuity exists in some part of the bone, though no crepitus is given with it. These circumstances may exist when the fracture is situated in the shaft of the bones, but cannot when near to either of their extremities; for here motion cannot be given without at the same time a crepitus being produced, for the surfaces are rough and broad and do not admit of separation, but only allow of the one being moved or rubbed upon the other.

The inner and fore part of the tibia being so superficial, and presenting its sharp anterior spine, which is only covered by the thin integument, renders great assistance in the examination of injuries of this bone, for no displacement can exist of the two portions of the tibia, when the fracture is situated in the shaft of the bone, without at once being recognized by passing the finger along its anterior spine; for any irregularity

along this surface will be easily discovered, and indicate the position of the fracture.

The point of fracture of the fibula, when it accompanies that of the tibia, as already stated, is not often exactly the same where the fracture is caused by the indirect force; for the fibula is found to give at a part distant from the point at which the tibia does, and so will cause the displacement and consequent deformity to be situated also at a part of the limb remote from that in the tibia. As a general rule, the fracture of the fibula is easily discovered when the patient is seen shortly after the accident; for though this bone does not lie so superficial as the tibia, its outer margin can be traced, and by pressing with the fingers along this surface, any depression or irregularity will be discovered; and any motion that may be given to the fractured ends, with the production of the crepitus.

The ends of the tibia cannot be displaced to any great extent without the ends of the fibula moving with them; for great displacement of the tibia implies great retraction, and great retraction of the one bone cannot take place without the other being drawn up with it. In these cases the point of fracture of the fibula is as easily discovered as that of the tibia.

Although the fracture of the tibia may exist and not be discovered, it is seldom that a fracture of the fibula is present without being known; for here the same circumstances are not present to render obstacles in forming the diagnosis. The length of the fibula and its thinness, cause the two portions of bone to be easily moved when it is fractured; for if the fracture be near to either of its articular extremities, pressure on the longer portion of bone will easily produce motion, as the fractured surfaces are so small and possess

little power of remaining in apposition when force is applied to them. The most frequent kind of displacement of the fibula is inwards towards the tibia; the fractured ends being driven in this direction, so as to cause a depression to be felt when the finger is passed along the outside of the bone; and if the bones unite with this deformity existing to any great extent, the foot becomes distorted outwards, as the fibula must be shortened at the same time, and the requisite support is not given to the outer side of the ankle joint, the consequence of which is—an unnatural degree of abduction of the foot, with a weakening of the internal or lateral ligament on the inner side of the joint.

Local swelling is more apparent in fractures of the bones of the leg than in many other fractures; for so large a portion of the tibia being superficial, having only the skin covering it, allows of the effusion of blood or serum to take place immediately beneath the integuments, and presents a circumscribed tumour opposite the seat of the fracture, and which may be taken as indicative of the presence of fracture, when the patient has fallen, and has not received any direct blow upon the bone. Of course this symptom must not be taken alone, but it will be sure to point out the probable seat of the fracture; and, as a general rule, I think the examination of the limb will prove that its situation accords with it, and that the point of fracture is beneath the tumour that is formed upon the surface of the bone.

It does not always happen, however, that this circumscribed tumour is present; for not unfrequently ecchymosis takes place to an immense extent, occupying the whole of the limb from the knee to the ankle, and sometimes beyond these points. The above re-

marks I have just made with regard to the seat of the fracture, of course do not apply here; for now the swelling occupies the whole limb, and is often sufficient to preclude the possibility of deciding upon the exact seat of the fracture, unless there be displacement as well. When this large ecchymosis occurs, some important artery or one of the large veins must be wounded: as a general rule, however, the ecchymosis in fractures of the leg is more formidable in appearance than in reality, for it is not uncommon to see great discoloration after this kind of fracture, and yet very little swelling; the reason of this is, that the fracture is so near to the skin, that the blood infiltrates and passes freely underneath it, and being immediately in contact with it, produces the discoloration. In fractures of the thigh, or any other bone surrounded by muscles, discoloration is not a common symptom; for the circumstance of the quantity of muscle round it, prevents the escape of the blood to the integuments, and so prevents the ecchymosed appearance.

Fractures of the leg, near to or extending quite into the ankle or knee joints, are generally attended with more tumefaction and ecchymosis than fractures of other parts of the bones; for now the accident is more frequently produced by the direct force, which necessarily bruises the soft parts more, and so gives rise to more immediate effusion round the ends of the bone, as well as causing the subsequent inflammation to rise to a higher degree; and if the fracture be into the joint as well, there is the additional increase of swelling produced by the secretion of the synovia, and by the inflammation which comes on as a necessary consequence.

The above circumstances must be borne in mind,

when examining an injury near to a joint, some time after it has been inflicted. No decisive answer can be given as to the existence of the fracture, when this great swelling is present; for as already stated, the usual symptoms may be so little apparent, and are often so difficult to be obtained, even when the patient is seen immediately after the accident, that now, when some time has elapsed, and the pain and tumefaction have arisen, it is more difficult still to decide, and more caution should be observed in giving an opinion as to the kind of injury that may have been produced. One thing then of great importance to observe, is the nature of the injury, and to endeavour to ascertain as minutely as possible the exact direction in which the force was applied, and the exact nature of the force; and if it is found that it could not have produced a fracture, and if the other symptoms, such as the absence of deformity, and motion, bear this opinion out, the chances are that the joint is the only part that has been injured, and that the bones have escaped. Under these circumstances, however, it will be safer to give no decided opinion, if some time have elapsed since the occurrence of the accident, but to wait until the swelling and inflammation have subsided.

Vesication of the skin takes place more frequently in fractures of the bones of the leg, than in other kinds of fracture. It is not uncommon after a severe simple fracture of the leg, when there is much effusion of blood, or other injury done to the soft parts immediately below the integuments, to find small vesicles formed at the point opposite the fracture, and in other situations. This vesication occurring under the above circumstances, within a short time after the injury, as four and twenty or eight and forty hours, is not to be

taken as a very alarming symptom, though any one ignorant of their occurrence in this kind of injury, might be disposed to consider them as the forerunners of deeper mischief, such as sloughing of the soft parts and cellular tissue beneath; whereas, I believe them only to be consequent on the irritation of the skin that is necessarily produced when any violent force has been applied to it, as must be in severe fractures of the leg. I have frequently seen these vesicles in simple fractures of the leg, and generally when the accident has occurred by the application of the direct force; they however subside within a few days after the injury, without any other mischief occurring to the skin. I am inclined to think, that the constitution of the patient also, has something to do with their formation, for I have seen them more frequently occur in those patients, who have lived irregularly, and in whom that peculiar brown unhealthy kind of inflammation comes on, which is so often seen after this kind of injury. I have, however, often seen them occur, when no inflammation of the skin has been present, but the sole cause of them has appeared to be the direct irritation produced to the skin itself by the injury. If the vesicles are very large and tense, they may be pricked with the point of a lancet, but if only small, they will subside gradually, under the application of cold lotions or fomentations.

TREATMENT OF FRACTURE OF BOTH BONES OF THE LEG.

The treatment of fractures of both bones of the leg, is as difficult, and perhaps more so, than any other kind of fracture: for it is not only the power of the

muscles that requires great force to overcome it, but there is another difficulty, namely, the disposition there is in the two portions of bone to slip from their line of apposition after they have been once reduced; and this difficulty is increased owing to the want of a point of resistance in the limb itself, by which any apparatus can be applied with the hope of fixing mechanically the ends of the bone. For although, as a rule, the employment of mechanical force in the treatment of fractures is to be objected to, it may be necessary in fractures of the leg; not, however, with the intention of reducing the fracture, but only of retaining the ends of the bones in their place, when their apposition has once been obtained.

I shall consider the treatment of this kind of fracture under three heads: First, those points that are important to observe in the reduction of the displaced portions of bone; secondly, the position that is best to place the limb in; and, thirdly, the mechanical means that are best adapted to keep the ends of the bone in apposition.

The reduction of this kind of fracture is often very difficult, for the muscles that cause the displacement are very powerful, and are chiefly situated on the posterior part of the limb, so as to pull the ends of bone often greatly behind, or to one side of each other. The first thing we have to consider, then, is the position of the muscles that are most disposed to contract, and to ascertain the precise point from which they act, and the position that is most likely to relax them.

The muscles that are most active in causing displacement of the fractured portions of bone are the gastrocnemius and soleus. The deeper muscles, no doubt, will also have influence in causing retraction,

though not to so great an extent; for their peculiar mode of origin, and the direction of the fibres, does not allow of much shortening; for they arise, throughout the whole of their length, from the bone to which they are attached; and consequently their fibres are obliquely placed, and are much shorter than they would be, had their origin been perpendicular to the point from which they act.

Relaxation of any particular muscle by position, implies that the joints that connect the bone at its two extremities, to which the muscle is attached, are so placed, in flexion or extension, that the origin and insertion of the muscle are brought nearer to one another; we have then so to place the limb in fractures of the leg, that this object may be obtained.

There is only one muscle, of any importance, that arises from the condyles of the femur, namely, the gastrocnemius. The plantaris and popliteus will not have much influence, if any, on the fractured portions. The other muscle that has importance, is the soleus, and its relaxation is dependant on the position of the ankle joint. The deeper muscles of the leg also, which I have said do not have much influence, are relaxed by the position of the ankle joint. The gastrocnemius is at once relaxed by bending the knee joint to a right angle, and the popliteus and plantaris at the same time. When the knee joint is bent to this right angle, the position of the ankle is of no importance, as far as the gastrocnemius is concerned; for its fibres are so much shortened, that complete relaxation is produced, and no further flexion is required.

The position of the ankle joint does not appear to be so important as that of the knee, for it is seldom necessary to take it from the angle it generally produ-

ces, when placed in the ordinary state of flexion; that is to say, when the foot lies at right angles with the leg. This circumstance would lead us to suppose that the soleus and the deeper muscles have not much to do with acting upon the lower portions of bone; for this position certainly does not relax them, but rather tends to put them on the stretch, with the exception of the three muscles that are placed on the anterior part of the leg. The position that would most tend to relax the soleus and the three deeper muscles at the posterior part, would be gained by extending the ankle joint to the utmost, by bringing the os calcis as far backwards as possible; but this is seldom necessary, nor is it advisable, for reasons I shall presently give.

The position most favorable then for the relaxation of the muscles, and the one that is found to be practically the best, is by placing the knee in a state of flexion, so that the tibia forms a right angle with the femur, and by placing the foot at right angles to the leg. There are two ways of doing this, the one is, by laying the limb on its outside, the patient's hip being bent, and the knee drawn up towards the pelvis; the other is, by resting the limb on its posterior surface, the patient lying on his back, with the leg raised to a sufficient height to flex the knee slightly. The former position is the one from which most relaxation can be gained, and therefore the one to be employed when there is much spasm in the muscles, and any great difficulty in reducing the fracture. The latter may be employed when this difficulty does not exist, and when the disposition to spasm is slight. It is always desirable, to place the patient on his back, if circumstances admit of it, for the length of time necessary to cure the fracture requires that the patient

should be placed in as easy a position as possible, to render his confinement less irksome to him. The position of placing him on his side, is certainly not desirable on this account, if it can be avoided, for it not only becomes irksome, but also endangers the recovery of the limb; for the ends of the bone are liable to get moved, and to have their apposition altered.

In the majority of cases of simple fracture of the leg, the spasm is not so much as to resist with any great violence, but yields sufficiently to allow of the ends of the bone being easily reduced, by position or slight extension. It is not, however, always so easy to retain the portions of bone after being so reduced; but this depends on another cause, namely, the obliquity of the fracture, and the absence of the locking of the two ends of the bone within one another. In the compound fractures of the leg, the difficulty is often very great, and sometimes cannot be overcome; but this depends on the original displacement being so much greater, and the injury generally being of a severer character. The degree of original displacement is no doubt the cause of the greater or less difficulty there may be in reducing the fracture; for when the bone is riding to a considerable extent, by the lower portions being drawn above the upper, the whole muscle is allowed to shorten to an unnatural degree, and the fibres are then put into spasm on the least attempt to bring them back to their original position; whereas if the displacement be but slight, the alteration in the position of the muscular fibres is but small, and they are not put into spasmodic action on attempting to elongate them to the slight extent that is necessary, in order to reduce the bones to their proper position.

In reducing fractures of the leg, an assistant should be placed so as to fix the knee firmly, either by raising it from the bed and then grasping it with both hands, or else by laying it on its side and pressing upon the inner surface of the knee: extension is then to be made by pulling upon the lower portion, the ankle and instep being grasped with both hands. The direction in which the extension should be made, will depend upon the position the displaced ends of the bone happen to be in. It should always be made downwards; but it requires to be forwards or backwards, inwards or outwards, according as the ends of the bone are riding in one or other of the above directions. Sometimes the ends of the bone may be got into their places, by holding the ankle in one hand and making extension, while the portion of bone is pressed upon just by the fracture, and attempts made to fit it into its place; some irregular kinds of fracture admit of being reduced in this manner, when extension alone is not sufficient; but of course there are many little points to be attended to which will facilitate the reduction, which will be indicated by the particular circumstances of the case, and which cannot be laid down as rules.

When the various kinds of fractures that are met with in the leg are considered, both with regard to their situation and the particular direction they may take, it is not a matter of surprise that a great difference should exist in the facility of reducing the ends of the bone into their proper place. When the fracture is simple, and situated in the shaft of the bone, near to the centre, as already stated, it most generally takes an oblique direction: and this kind is often found difficult to reduce, so as to bring the two portions of bone into

exact apposition, or at any rate, to keep them there. For, although the muscular action can be overcome sufficiently to allow of the ends of the bone being brought opposite to one another, the direction of the fracture will not allow them to remain there; but the moment the extension is removed, the surfaces slide one upon the other, and the one portion is retracted, so as to cause the portion which is the most anterior to project beneath the skin: and it is often impossible to prevent the end of the bone doing so, although the leg may otherwise be of its natural shape, and unite without further deformity. The shortening in these cases is comparatively nothing; for a very slight retraction, or simple displacement backwards of the lower portion, will be sufficient to cause the upper one to be prominent.

The above remarks refer to the most frequent kind of difficulty that is met with in reducing fractures of the leg: there are some cases, however, of the simple fracture in the shaft of the bone, that are so much displaced, when the line of the fracture has extended in more directions than one, and when the force that produced it has been very violent, that all attempts at reducing the ends of the bone are of no avail, and the union takes place with great deformity. These cases, however, are rare with simple fracture of the leg. It is not uncommon to meet with severe cases of compound fracture, when the ends of the bone are so much displaced, and with the upper portion projecting through the skin, that it is quite impossible to reduce them; the alternative then is to saw off the projecting portion as high up as may be requisite to replace it: and here I may make some remarks as to the mode of doing this, as it is not always necessary to remove the

whole of the projecting portion, which is an important point to consider, as the more bone there is saved, the less lameness in the limb will remain afterwards.

Of course no decision should be come to upon sawing off the bone, until every attempt has been made to reduce it to its proper position. The knee joint should be flexed to the utmost, and extension made in every direction that the particular line of the fracture indicates. Very often a kind of see-saw motion, at the same time, will unlock the ends of the bone, as well as disentangle them from the muscles; which, no doubt, is often the cause of the spasm that continues with so much force. Again, it does not follow that because the spasm cannot be subdued immediately after the injury, that the same difficulty will remain four and twenty hours afterwards. I should say, that if the fracture be not severe enough to render amputation necessary, that time should be allowed to see if the spasm will subside, and if simple extension made upon the limb, after the muscles have been relaxed, be not sufficient, that other means should be resorted to, such as taking away blood from the arm, or giving nauseating doses of antimony; the former remedy will of course be guided by the constitution of the patient, and by the loss of blood he may have sustained by the injury.

Although, as a general rule, I believe that it is bad practice to let a fracture remain unreduced, the compound fracture admits of being so tried, when the only alternative is that of sawing off the ends of the bone; for although the limb may be saved oftentimes by this treatment, the length of time for the cure is generally so tedious, that every chance should be taken of reducing the fracture before having re-

course to the above means. Many a simple fracture can be reduced four and twenty or eight and forty hours after the injury has been received; and I believe that many a compound one might be too, where the practice of sawing off the end of the bone is had recourse to, which the surgeon is often inclined to do at once, if he cannot get the end of the bone back into its place the first time he makes the attempt, and the natural fitting or contact of the two ends of the bone, even if it be deferred four and twenty hours after the fracture, will produce less subsequent mischief to the limb and constitution of the patient, than the reduction of the bone with a portion of it sawn off; for in the former case, the soft parts around are at once adapted to the position of the bones; while in the latter, not only do the soft parts, as muscles, nerves, and arteries, become altered in position owing to the shortening of the limb, but the ossific process itself is interfered with, and is a longer time in being completed, owing to the above circumstances, as well as the bad apposition which is generally got in these cases.

If, however, all attempts at reducing the fracture be of no avail, and the fracture be not severe enough to render amputation necessary, the only treatment is, to remove the projecting portion of bone. It is not often necessary to remove all the bone that projects through the skin, for although the whole of it cannot be reduced, some portion of it can, by relaxing the muscles, and extending the lower portion from the upper. This should be always done before sawing off the end; and it should be observed how much is left unreduced by so doing; that is to say, after the limb has been placed in the most favorable circum-

stances for the reduction, and the lower portion pulled well down, it should be remarked how much still overlaps, and this is the only portion that it is necessary to take away; and in many cases it will be found that a small piece is sufficient to prevent the reduction, though the original projection might have been to a great extent, before the limb was pulled upon by drawing down the lower portion.

The end of the bone should not be sawn off indiscriminately in any direction; the object not being only to reduce the bone, but to make it fit the fractured surface of the other portion with which it has to be placed in apposition. If then the fractured end of the fixed portion take any particular obliquity, the projecting portion must be sawn off accordingly, so as to make the two lie as evenly in contact as possible; for it is quite obvious, that if the fractured surface of the one portion of bone be oblique, and the projecting portion be sawn off transversely, that the two surfaces not only will not fit, but the process of union will be rendered longer and more tedious.

When the end of the bone is to be sawn off, a lath splint or any substance that will protect the skin should be placed underneath the projecting portion. Sometimes the wound in the skin through which the bone protrudes, is at some distance, from the line of the fracture, in which case the end of the bone must be sawn off without making any reduction before-hand; for the line at which it may be necessary to remove the portion of bone might be drawn within the wound, and then too small a portion would be taken off. If, however, the wound be opposite to the line of the fracture, and the exact piece of bone that prevents the reduction can be seen, extension may be made

upon the lower portion, so as to bring it down as low as possible, and while held in this position it may be removed, when if the calculation made have been good, and if the direction of the saw have been in the proper line, the ends of the bone will slip into their place. As a general rule, however, whether the wound be opposite the fracture or not, the necessary portion of bone to be removed had better be sawn off, with the ends of the bone relaxed, having ascertained previously the exact portion that opposes the reduction.

Having reduced the ends of the bone to their proper place, as near as circumstances will allow, the next point to be considered is, the position the limb is to be placed in for the remainder of the treatment, and the best means to be employed to keep the portions of bone in the apposition that has been obtained. There are two points to be considered with regard to the position of a fractured leg; the first is, the existence or not of spasm after the reduction has taken place; the second is, the nature of the fracture, whether it be simple or compound, and if compound, where the wound is situated.

The existence of spasm in the muscles after a fracture, as already stated, is brought on oftentimes by the direction of the fracture being so oblique, that the ends of the bone are not locked within one another; the consequence of which is, the one portion becomes at first slightly displaced, which is sufficient to alter the position of the muscular fibres, and then spasm comes on and increases the displacement. In placing a fractured leg then, when the line of fracture is very oblique, that position should be chosen if possible, that tends mechanically to oppose the sliding of the one portion off the other. Thus if the fracture take a

direction downwards and forwards, the limb should be made to rest on its posterior surface; if laterally downwards and inwards, it should rest on its outer surface; of course circumstances may modify the necessity and manner of employing these two positions. The degree in which the different joints are to be flexed, will depend on the disposition to spasm after the bones are reduced. As a general rule, the oblique fracture requires the muscles to be more relaxed than when it is transverse; for when the fracture takes a transverse direction, it seldom requires much consideration with regard to the relaxation of the muscles, for the ends of the bone are so locked against one another, that they remain stationary, and have no disposition to be moved after being once reduced.

When the fracture is compound, the situation of the wound must be considered with regard to the position the limb has to be placed in, and that position must be chosen that causes the least pressure to be made upon it. It fortunately happens in compound fractures of the leg, that the wound is generally situated on the anterior or inner part of the limb, so that the leg can be so placed, that none of the pressure shall tell upon the soft parts. This is not always the case, however, for sometimes when the direct force has acted, the outer or the posterior surface of the leg is included in the laceration, and then it becomes necessary to press in these situations to support the limb, for then it cannot be placed either on its fore or inner surface. When the wound is on the posterior part, the leg must be laid on its outer side, and when it is situated on its outer surface, it must lie on its posterior surface; and if it extend in both these directions, the outside of the limb must be chosen, for the pressure

can be better regulated, and is not so great as when resting on the heel. What is called the interrupted splint may also be employed, which supports the limb without pressing on the wound: of this I shall speak presently.

In fractures near to the ankle joint, it is often difficult, and sometimes impossible, to reduce the ends of the bone to their proper apposition, for the reasons already given, when speaking of the particular direction the fracture may take. The fracture in this situation is generally transverse, or, at any rate, not sufficiently oblique to favor the sliding of the one portion from the other. The structure of the bone being more loose or cancellated than the shaft, helps to lock them together. Another and very important reason of the difficulty of reducing these kinds of fracture is, that the lower portion of bone is so small that it cannot be grasped individually, but can only be acted upon by pulling through the ankle joint—which gives very little power, while at the same time the resistance to be overcome is very great. This kind of deformity is seen in the drawing at page 465; which could not be overcome by any means that were employed—either by relaxation of the muscles, or by great mechanical force.

The position of the limb will also be governed by the kind of apparatus that is employed: for some admit of the leg only being placed on its side, while others allow of its resting on its posterior surface only; so that, according to the degree of displacement, and the disposition to spasm that may come on in one position more than another, will it be necessary to employ one kind of apparatus in preference, as being able to accommodate itself to that position in which it

is necessary to keep the limb during the remainder of the treatment.

I proceed now to consider the various means that are employed in the present day to confine the fractured leg; and shall explain the principle on which they each act, and the mode of applying them.

Fractures of the leg, in the present day, may be said to be treated by position only; and this has chiefly been the practice since Pott's time. I shall not therefore mention the many kinds of machines (for such they were) that have been employed to act upon the fractured limb; for they are now quite forgotten.

The most simple mode of treating fractures of the leg is the one advocated by Pott; here, as in fractures of the thigh, he made position his grand object; and so placed the limb, that all the muscles might be relaxed as much as possible, by which little or no mechanical violence is wanted afterwards to confine the portions of bone. The position is that of placing the limb on its outer side, by flexing the hip and knee joints, by which the most powerful muscles are relaxed, and then further disposition to spasm prevented. Pott says, "In the fracture of both tibia and fibula, the knee should be moderately bent; the thigh, body, and leg, in the same position as in the broken thigh. If common splints be used, one should be placed underneath the leg, extending from above the knee to below the ankle, the foot being properly supported by pillows, bolsters, &c.; and another splint of the same length should be placed on the upper side, comprehending both joints, in the same manner."* This treatment I should say is decidedly the best that can be employed in many cases of fracture of the leg; and

* Page 659.

its great recommendation is, that it is so simple in its application, and requires no apparatus to be employed but what can be obtained almost under any circumstances. The splints Pott mentions consist merely of straight pieces of wood, placed on either side of the limb, to steady the two portions of bone: an improvement on this, is what is called Sharp's splint, which I shall speak of again.

This treatment, recommended by Pott, though so simple, and easy of application, and often so beneficial in its results, has its objections. There is still the same objection here as there is in his treatment of fractures of the thigh, namely, the tediousness and inconvenience of keeping the patient confined for so great a length of time on his side—the consequence of which is, that he is disposed to turn on his back; and he cannot do so without moving the leg from its position. The level of the knee therefore gets altered, and to a great degree, if the fracture be very moveable; for the foot will remain flat on its outer side, while the upper portion of bone is taken with the knee. And, even if the patient remained on his side, great care is required to keep the knee and foot in their proper relation to one another; and to see that the pillow on which the foot and ankle rest, does not sink so as to allow of abduction taking place to an unnatural degree. This latter can hardly be called an evil however, for it can be easily prevented by care and attention to the position of the limb, and by altering the pillows on which it rests.

Sometimes the fracture is easily kept in position, and no spasm is present; so that nothing more is required than to lay the leg on its outer side, without any splint at all, and merely flexing the knee and hip; and

placing a firm elastic pillow beneath it; and taking care to keep the foot supported at a proper level with the knee. Many fractures of the leg will get well in this way, without anything further being done to them. The cases that admit of this simple treatment, however, are those where, after the bone has been reduced, it remains easily in apposition; as when the fracture is transverse, or takes such a direction that the ends of the bone can be locked against one another; and when the muscles are not disposed to act spasmodically; or, if they do so act, have not power to displace the ends of the bone.

It is often advisable to adopt the above position at first, though it may be requisite to alter it at a later period of the treatment; for the limb may be so much bruised or swollen—or the spasm may be so great in the muscles—that it is quite impracticable to use any means that confine the limb, or to place it in any position that puts the muscles on the stretch. When the swelling has subsided, and the soft parts recovered themselves, a more favorable position may be chosen, and can then be adopted.

Sharp's splints consist of two portions of wood, or iron, hollowed out and made of the width of the leg—they also take the shape of the limb. The outer splint, on which the leg rests, is, in addition, curved forwards, to support the foot as well as the leg; there is also a place hollowed out for the external malleolus. The inner one is shaped like the outer, but only extends down to the heel, without any foot-piece; and is also perforated for the inner malleolus.

The splints are kept in place by three or four straps, or by passing strips of bandages round them. Before applying them they should be padded with a

few layers of flannel or lint; which is better than tow or wool, as it makes even pressure on the limb. The leg should also be rolled from the toes up to the knee. The position of the leg is to be the same as that just spoken of, namely, on its outer side, with the knee and hip joints flexed.

One advantage of the Sharp's splint is, that it allows of the limb being easily examined; for it is only necessary to undo the straps, when the upper splint can be taken off, while the limb remains steady on the lower one; and any mal-apposition of the ends of the bone can be remedied, and the splint be again applied: it has however the same evil of confining the patient on his side, as when Pott's treatment is employed. Sharp's splint prevents the foot turning out; for if the knee be firmly fixed to the upper part of the splint, the foot must remain on the same level, as the wood on which it rests cannot bend, although the pillow may sink at one part more than another. Want of attention, however, in fixing the knee firmly to the splint, will allow of the same evil as when the limb is placed on a pillow only, without any splint at all.

A very good and effectual way of treating fractures of the leg, where the bones have little or no disposition to displacement, is by employing thin lath splints, placing one on the inner and outer side, and one on the fore part of the limb. The limb is first of all to be evenly rolled from the toes upwards to the knee, to confine the muscles, and to guard the skin from the pressure of the splints. The anterior lath splint may be bent to allow of its passing forwards some little way on the instep, and so to fix the ankle joint. These splints may sometimes be employed from the first, though this rarely happens in fractures of both bones;

but in fractures of the tibia or fibula singly, so little local irritation comes on in some cases, that the limb may be confined from the time of the fracture till the patient leaves his bed, without producing any inconvenience. In general, however, in fracture of both bones, the local irritation will not allow of this early confinement of the limb, but requires some time for the swelling and inflammation to subside, before any pressure directly opposite to the fracture can be borne.

None of the above modes of treatment are applicable when there is any disposition for the one portion to ride upon the other; for neither Sharp's nor Pott's splints can have any mechanical advantage over the ends of the bone, all they do is to steady the two portions of bone generally, and keep the joints that are connected with them at rest. And this is all that is required, when the position into which the limb is placed acts favorably, and allows of the easy reduction of the bone, and of the perfect relaxation of the muscles. Some mechanical advantage may be gained by the lath splints in those cases where one end of the bone is inclined to project forwards, owing to the peculiar direction of the fracture; which however does not oppose the reduction, but becomes easily displaced again after the extension is discontinued. A lath splint placed on the anterior superficial surface of the tibia, with a simple compress of lint beneath it, in many cases acts beneficially, by keeping the ends of the bone on their proper level.

The treatment I have just described, renders it necessary that the limb should be placed on its outer side, in order to allow of the easy adaptation of the different means necessary to fix the two portions of bone. And though in many cases this position is the

best, and the only one that admits of the easy reduction of the fracture, in the majority of cases it is not necessary; for there are other modes of treatment that require the limb to be placed on its posterior surface, resting on the heel and calf of the leg, which are found to answer perfectly well, and without the inconvenience of laying the patient on his side. I shall mention the various means by which fractures are treated in this position, beginning with the most simple.

The position of resting the leg on its posterior surface, does not relax the muscles to the same extent that the lateral position does, at least when the means that I have first to speak of are employed; but there are some kinds of apparatus that admit of the complete relaxation, as the knee can be bent to any degree required.

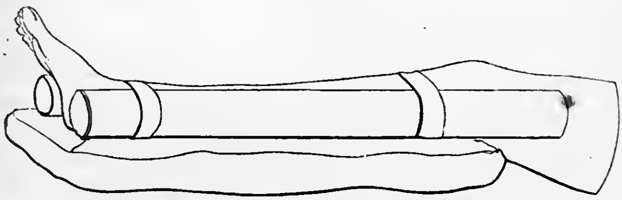
Although, as a principle, it is well to bear in mind the power the muscles have upon a fractured bone, it is not by any means in the majority of cases that this power is exerted, or at any rate the majority do not often require these means to prevent it. I mean by this, that although in fractures of the leg it is often necessary to adopt position as one of the first principles in its treatment,—there are many, and I should say, from my own experience, the greater number, which are quite as easily treated by placing the limb on its posterior surface, with the knee joint so little bent that no relaxation of any importance can be gained by it. This fact only shews that in many cases of fractures of the leg, either from the peculiar direction of the fracture, or from the absence of spasm, that the muscles are not inclined to act, so as to cause displacement; but of course this does not do away with the necessity and importance of knowing the principle on which the

position acts; for though these cases are not so numerous as those that can do without it, they are still by no means uncommon. The importance of attending to position in fractures of the thigh, I have already mentioned, when speaking of that kind of injury.

The apparatus that is the most simple and most easy in its application, as well as at the same time the most generally beneficial in its results, is what is known by the name of "the junks." The principle on which they act, is by confining the limb on either side, the pressure being made by two rollers of wood or straw, long enough to extend below the ankle and above the knee. These rollers are included in a piece of sheet or linen cloth of any kind, by being rolled within it, the leg resting on the central portion of the cloth; the cloth of either side is then rolled up until it comes in contact with the leg, the one on the outside pressing upon the outer surface of the knee, leg, and ankle; that on the inner side pressing on the opposite surfaces; the back part is lying on a pillow, and the anterior part is left free and exposed for the application of lotions, &c.

When applying them, they are given to an assistant, while the surgeon takes charge of the limb; and whatever reduction of the fracture may be necessary, is first of all to be made; the leg is then raised from the bed, by grasping the knee by the ham with the left hand, while the foot and instep are grasped with the right; when raised to a sufficient height, the junks are to be placed beneath the limb, moving the pillow and all together; the pillow should extend a little above the knee joint, and be long enough to pass below the heel some way, as the heel must rest on the substance of the pillow and not just at the edge of it.

When the junks are properly applied, the upper end should lie in contact with the side of the knee, and the lower end with the side of the ankle and foot. The position of the foot can be varied at pleasure, by passing a piece of bandage round it, and pinning it to the side of the junks. The drawing represents their application.



The advantages of this treatment are the following: it fixes the leg firmly; for if the rollers be evenly applied, the pressure will tell all along the limb; the difference in the thickness of the knee and ankle is remedied by giving the lower end of the junks an extra turn. Any degree of pressure can be made by turning the rollers more or less as may be required. The anterior part of the leg is always exposed and open to inspection; the finger can be passed down the anterior spine of the tibia, and any irregularity easily detected; and if displacement be dependant on position only, and not upon spasm, the heel can be raised or depressed according to circumstances, by putting a compress or small pillow beneath it, and so remedying the evil without difficulty.

The above is the description of the junks, as they are employed at the Middlesex Hospital, and at many others; and I should say, from my own experience, they are more beneficial than any other kind of treatment, especially at the early stage after the injury,

for the first ten days or a fortnight. Afterwards, when the bones begin to consolidate, they may be discontinued, and the simple lath splints applied in their stead.

Some authors in objecting to the employment of the junks, mention what they call the short junks, which do not include either the knee or ankle. I never myself saw these employed, nor heard of their being recommended by surgeons of experience; and I cannot conceive any one wishing to steady a fractured leg without fixing the knee and ankle at the same time. Mr. Amesbury talks about the ends of the tibia and fibula being approximated; it is impossible for this to take place when the proper junks are employed, that extend above the knee and below the ankle. The only possible evil that can arise during the employment of the junks, is the sinking of the one or other portion of the bone posteriorly, owing to the pillow on which the limb rests yielding; now this is so easily guarded against, by having the pillow firmly stuffed, and by putting additional padding after the first day or two, when the pillow will have yielded to its utmost, and then there will be no further fear of displacement. Besides, the displacement that does take place, if the pillow originally be a good one, is so slight, as sometimes not to require any alteration after the first application of the apparatus. Whatever are the objections that can be made to the junks, I can only say that out of the many cases of fracture of the leg that I have seen, the majority of them have been treated by the junks, and the union has turned out so satisfactorily, as to leave an impression in my own mind that for fractures of the leg in general, either compound or simple, when the spasm is not great, the

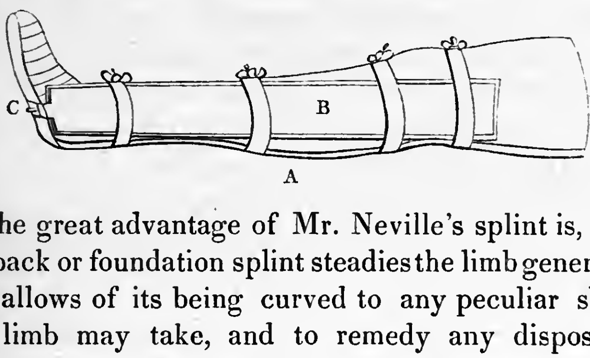
junks are decidedly the best treatment that can be adopted, for it is the simplest and at the same time the most easily obtained. They may be continued for the first fortnight or three weeks, when the ends of the bone will have become sufficiently consolidated to allow of the application of the lath splints, and then there will be no fear of altering the position of the limb, for it can now be laid on its side on a pillow, and any motion of the patient will not produce the mischief that it might at an earlier period of the fracture.

The principle on which the junks act, whatever their construction may be, is merely to steady the limb generally, by making pressure on either side of it, so as to include the ankle and knee joints; and if these two parts be well steadied, and their relative position also be correct, the intermediate portions of bone will also be in a right line, if there be no predisposition to spasm in the muscles of the limb. The limb being placed on its posterior surface, does not at all interfere with the apposition of the ends of the bone; and gives the patient the additional advantage of lying on his back, which is so much less irksome, when the same position has to be continued for any length of time. As already stated, they are not adapted to those cases where there is great disposition for the ends of the bones to become displaced; as is the case when the fracture is very oblique, and the spasm of the muscles very strong. In these cases the knee joint must be flexed, and the limb laid on its side, or upon the inclined plane, so as to relax both the ham-string muscles, which pull upon the upper portion of bone; and the gastrocnemius, which pulls upon the lower. In the majority of cases, however,

the spasm is not sufficient to prevent the limb being placed on its posterior surface, however much theory might lead us to suppose that such would be the case.

I come next to speak of an apparatus that I do not believe to be in general use, but which in many cases can be employed with the greatest advantage. It was invented by Mr. Neville, and will be found described in the 7th vol. of the London Medical Gazette. It consists of a back splint curved below to fit the sole of the foot, and extending upwards to about half way up the thigh; the width of this back splint is about two inches; it is made of iron, strong but flexible enough to admit of its being adapted to the size and shape of the calf; it is padded with a cushion made of a few layers of flannel, covered with wash leather. This splint Mr. Neville calls the foundation splint. The rest of the apparatus consists of two lateral splints made of thin but flexible iron; their length extends from the foot-piece of the foundation splint up to the knee joint; they are connected to the piece at the sole of the foot by means of two small perforated bars which turn underneath, and fit on a projecting button, and are fixed by a small peg passing through it. The width of the splints is from three to four inches, and are well padded with flannel covered with wash leather; their width allows them to make very general pressure on the sides of the limb, which is done by means of three or four tapes or straps passed round them, and behind the back splint; while the flexibility of the material of which they are made, allows of their close adaptation to its surface throughout their whole length. The back splint is first applied by bending it to the curve of the posterior part of the limb, taking

care that the part of the limb above the heel be as much supported as the heel itself, otherwise sloughing of this part will be liable to occur; an extra pad of tow or cotton may be placed underneath the heel, to secure it more from the pressure upon it. When the foundation splint is fitted to the back part of the leg, and the foot is found to rest flat on the sole-piece, a roller is to be passed from the toes upwards to the knee, round the splint and limb, so as to fix the two firmly together. The two lateral splints are then to be fixed on to the button under the sole of the foot, and to be fastened to the leg by means of three or four straps or tapes. The drawing represents the apparatus: A the back splint, B the side splint, which fastens under the sole of the foot at C.



The great advantage of Mr. Neville's splint is, that the back or foundation splint steadies the limb generally, and allows of its being curved to any peculiar shape the limb may take, and to remedy any disposition there may be in one portion of bone to rise above the other, by making greater or less pressure as may be required, so as to elevate or depress the heel. The lateral splints have no great mechanical power over the portions of bone; they however assist to steady and support the limb generally, and guard against lateral displacement, if the limb fall to one side more than the other. The whole apparatus when applied

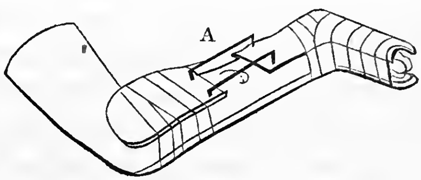
looks very compact and neat, and the patients express themselves as feeling great comfort and support from it.

The above splint is particularly applicable when the patient is inclined to be restless. In these cases the junks are not sufficient, and which is one objection to their employment; for they allow of the limb being turned round within them, or being pulled out altogether; but patients who do this are the exceptions, and not the general rule. Mr. Neville's splint, however, completely guards against any such accident, and fixes the limb so securely by the back splint, that when the limb is firmly bandaged to it, and has the lateral splints also firmly applied, the patient may throw his leg almost in any direction, without the fear of displacing the portions of bone. I have often succeeded with restless patients by employing the above splint, when no other means would do to steady the portions of bone; for it will be seen that as the foot and back splint are all one piece, that the foot, ankle, leg, knee, and thigh are rendered immoveable, as it is made to extend half way up the thigh, as well as below the sole of the foot. It is also particularly applicable to compound fractures of the leg, where the wound is situated in the front or to one side; for the whole limb can be steadied without making any pressure on the wound. The limb is to be laid on the back splint, as in the simple fracture, but the bandage is only to be applied to the sound part of the limb; that is to say, supposing the wound to be in the middle of the leg, the roller is to be passed from the foot upwards, round the ankle, up to about an inch of the wound; the knee is to be fixed in the same manner, by beginning the bandage above the wound and car-

rying it up the thigh. By this means the whole limb is fixed, and the two portions of bone also, and the wound is left open to be dressed: when the dressings are applied an additional strip of roller may be used, or the eight-tailed bandage may be employed, which will render it unnecessary to move the limb at all after the first application. The patient must be questioned as to the pressure on the heel; for if it be not well padded, and the precaution be not taken to curve the splint properly, as I have already mentioned, irritation of the skin may be produced; which, if not attended to, may go on to more serious mischief, and produce sloughing. I once saw sloughing of the heel produced by this splint, but the patient was an old man, and did not complain of the pain which he must necessarily have felt before the irritation had advanced so far. I merely mention this as a precaution it is necessary to take when this splint is used, and not to make it an objection to its employment; for I look upon all those evils that occur, which a little care and attention might prevent, to be owing to the abuse and not the use of the means that may have caused them.

Another very useful kind of splint for compound fractures of the leg, when the wound is on the inner side, and of great extent, is what is called the interrupted splint; it is merely a modification of Sharp's splint. It consists of the outer wood splint shaped to the foot, on which the leg rests, when the limb is placed on its outer side, precisely in the same manner as when Sharp's splint is employed. The inner splint, however, instead of being continuous throughout, has a portion of it removed in a situation to correspond with the position and size of the wound; these two

portions correspond, the one to the part of the leg above, the other to the part below the wound; they are joined together by means of two small bars which are thrown into a curve, so as to form a sort of arch over the wound, leaving the intermediate space quite open, but still connecting the two portions of the splint together, as if it were one. The drawing represents it: A the interrupted part opposite the wound.



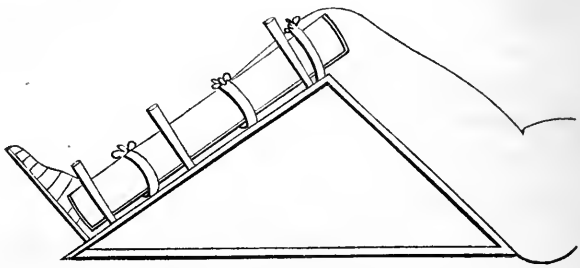
The two splints are fixed to one another by a few turns of bandage passed round the ankle and foot, and below the knee, which will have no occasion to be removed when the wound is dressed, but may be continued without re-adjustment, until they give the patient uneasiness, from any unequal pressure of the pad, or irritation of the skin.

The use of this kind of splint is, that it may be employed with all the advantages of the continuous splint; for the purchase is the same as though it were one piece of wood, and the two portions of bone can be equally as well steadied, and the apposition will not require to be disturbed; for the wound being exposed, can be easily dressed, without moving any part of the apparatus, or otherwise disturbing the limb. The cases to which the above splint is peculiarly applicable, are those where the wound is quite on the inner side of the leg, and of very large extent; and

when the fracture is either comminuted, or takes such a direction as to render the portions of bone quite moveable; for now the best position for the limb is on its side, and if so, no apparatus fixes the bones so well as the Sharp's splint, with the above modification for the wound.

There is, however, another mode of putting the principle of relaxation of the muscles into practice, by flexing the knee joint, and still keeping the limb on its posterior surface, and allowing the patient to remain upon his back. The common inclined plane is the means by which this may be done; for the knee can then be bent to any angle, and of course the muscles will be relaxed in the same degree as if the knee were bent with the limb lying on its outer side. The same precautions should be taken in adjusting the plane, that were pointed out when speaking of fractures of the thigh, namely, to see that the leg part of the plane is long enough for the limb to rest easily upon it, and to take care that the angle of the plane corresponds to the angle of the knee. The foot-board must be adjusted so as to let the sole of the foot rest firmly, yet easily, upon it; so that no strain may be given to the lower portion of the tibia. The lateral parts of the leg may be supported by two broad split splints, fastened on either side by tapes or bandages being passed round them. The leg may be further steadied by placing thin cushions or pads between the lateral splints and the pegs, that are always made to fit into the common inclined plane. The leg by this means is firmly fixed in a kind of box, and the foot is steadied by a few turns of bandage passed round it and the foot-board.—The wood-cut represents the leg adapted to the inclined plane, with the side splints

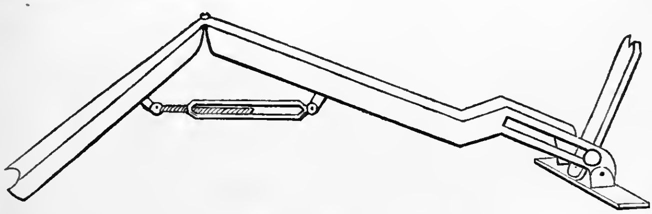
and pegs to support the limb in conjunction with the foot-board.



The inclined plane relaxes the ham-string muscles and the gastrocnemius, at the same time that it allows of extension being made upon the leg; for if the knee fit the angle of the plane well, a fixed point is gained for the upper portion of bone, and if the foot fit the foot-board evenly, extension can be made upon the lower portion by depressing it as much as possible. The limb is steadied laterally by the means already mentioned, namely, by the splints and pads. These means I have seen succeed in preserving the apposition of the ends of the bone, when the fracture has been very oblique, and the spasm of the muscles very great.

Another apparatus which may be employed with great advantage in some cases, where the fracture is very oblique, is one used by Mr. Liston: it is a modification of M'Intyre's splint. It consists of a thigh and leg piece, connected to one another by a hinge; they are made of iron, and hollowed into a kind of trough, to allow of the limb lying easily upon it. The angle of the plane is altered at pleasure, by means of a screw, which turns at the under part of the splint, opposite to the knee. The foot is attached to a moveable foot-board, which slides in a groove at the bottom

of the leg part of the apparatus, and is capable of being fixed by a screw. The greatest advantage, however, gained by this instrument is from the lower part of the leg piece being absent behind, so that the heel can be raised or depressed at any level, by adapting the bandage that fastens it to the foot accordingly, and any angle that the two portions of bone form with one another can be remedied by so doing. The drawing represents the splint.

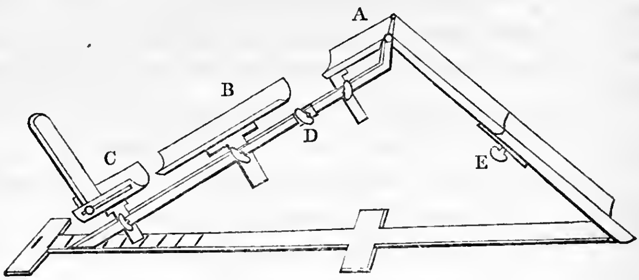


None of the above splints, however, gain a point that it has always appeared to me desirable to obtain, namely, the power of making pressure separately on one part more than another, so that any rising or depression of the bone can be remedied, without the necessity of altering the position of the whole limb; and every one who has had much experience in treating fractures of the leg, must have met with cases where it has been desirable to depress the heel, or to raise it more than the rest of the limb; and others, where more pressure, or a greater degree of elevation, has been required at the middle of the leg or at the upper part. Now these objects cannot be gained by the common means, for the leg part of the apparatus is made of one continuous piece, and only admits of the position of the bone generally being altered, and not separately at one part more than another.

It appears to me that before this point can be gained, the leg part of the splint itself must be made of sepa-

rate pieces, so as to admit of one being moved without the other; by which the level of the limb can be altered in parts, without altering the pressure on the rest of it.

I think this object might be gained by employing the following kind of splint. It consists of a leg and thigh piece, like the common inclined plane; the thigh part having a slide to it, to adapt it to different lengths, and being fixed by the screw E. The leg part of the apparatus consists of three portions, A, B, C; which admit of being raised or depressed at pleasure, by means of a slide which is connected to the under part of each, and which passes through a back bar which connects the thigh splint to the rest of the apparatus. These slides are fastened by a screw, which turns against each of them. The foot piece, C, has a footboard connected with it, which allows of the angle being altered at pleasure by means of a slide in which it moves. The wood-cut represents the apparatus.



The principle of the apparatus is precisely that of the common inclined plane; and the limb is adapted to it in the same manner. The peculiar points gained by it are the following:—if the knee part of the leg be wanted to be placed at a different level to the rest, the part A may be moved; if the central part—B may be raised or depressed; and if the foot part—C is to be

moved so as to bring the heel up or down, as may be required. It will be seen by these three moveable pieces, that any prominence that may exist in one part of the leg more than another, can be remedied, as the pressure can be increased or diminished opposite to any part, according to the situation and degree of the displacement of the ends of the bone. The exact length of the leg part of the splint is gained by the slide D, and that of the thigh, by the slide E. The splint might also be used for fracture of the thigh; for the slide admits of its adaptation to limbs of different lengths, and the leg part would support the rest of the limb, in the same manner as the common inclined plane, by keeping A, B, C on the same level.

Although I have recommended the junks, Sharp's, Neville's, the lath splints, and the inclined plane,—as being the apparatus that will generally succeed; there is no one of them that will be found applicable to all fractures, but the surgeon must be guided by the circumstances of the case, as to whether the limb should lie in the extended or flexed position, and adopt that apparatus which will best fulfil the indications pointed out by the peculiar nature of the injury. The remaining point to be considered, is the time that it is necessary to confine the patient to his bed, and the treatment when he first gets up.

As a general rule, when both bones are fractured, from four to five weeks will be found long enough to keep the patient in the horizontal position. There are cases, however, when a longer or shorter period may be advisable. In the simple fracture of both bones of the leg, a great deal depends on the direction of the fracture; for it must be quite obvious that when the fracture is transverse, the patient can bear upon the

limb at an earlier period, without any danger of separating the two portions of bone; for if the patient place the foot flat on the ground, the ends of the bone are locked against one another; whereas, in the oblique fracture of the tibia, there is not sufficient resistance offered by the ends of the bone, but all the strength gained is derived from the callus that has formed around them. This being the case then, it will not be safe to bring the weight of the body directly on the fractured bone, at so early a period as when the direction of the fracture is transverse; for, in the one case, the support may be said to be artificial; while, in the other, it is nearly natural. If the fracture be very oblique then, and there have been great difficulty in keeping the ends of the bone in contact, six weeks or more will be necessary to ensure the consolidation of the fracture. In all cases, however, the surgeon must be guided by the actual state of the fracture, there being no decided rule as to the period of confinement. In compound fractures of the leg, the period required is much longer; for not only does the fracture require a longer time to unite, but there is the reparation of the soft parts also to be waited for.

When the patient leaves his bed, after a fracture of the leg, some precautions should be taken to guard against any unequal pressure or strain upon the ends of the bone; for although the union may appear firm and sufficient to resist a moderate force, it has to be remembered that at this period the fractured surfaces themselves are not united, but that it is merely the provisional callus that keeps them together. The limb then should have strips of soap or other kinds of plaster applied opposite the fracture, and two or three lath splints besides; one on the outer, inner, and fore

part, with a bandage firmly and evenly applied from the toes up to the knee.

It is the practice of many to recommend the patient to wear a sling round the neck, and passed under the foot; so as to support the fractured limb, and to allow him to bear upon it by degrees. I am not sure that this sling is to be recommended, at any rate without some other precaution being taken, for the patient is apt to walk more upon the toes than the sole of the foot, and if so, the pressure opposite the fracture must be unequal, and more particularly if the fracture be oblique as it generally is through the tibia. The consequence of which is, that an angle is formed opposite the seat of the fracture, and a deformity produced, if it be not early remedied. The way to guard against the patient walking on the toes more than the sole of the foot generally, is to prevent him bending the knee, and this is done by placing a splint behind the knee joint; for it will be found that if the knee cannot be bent, the foot must be placed flat to the ground, and as much pressure will be made upon the heel as upon the toes. I should always recommend then, when the patient first begins to walk after a fracture of the leg, that in conjunction with the sling, there should be a strong splint placed behind the knee joint, and to be worn 'till the patient gets confidence, and can place the foot down flat on the ground with facility.

It will be well to continue the support to the limb for two or three weeks after the patient begins to walk about. The splints, however, may be left off before the soap plaster and bandage are, for the muscles will be benefited by the support, as well as the circulation in the limb, although the mechanical resistance opposite the seat of fracture may be no longer necessary.

FRACTURE OF THE TIBIA SINGLY.

The tibia is not so often broken by itself as the fibula; for a force that is necessary to fracture so thick and strong a bone, generally extends to the smaller and weaker one afterwards, and so causes the two bones to be broken together, and but rarely to stop at the tibia only. The fibula, however, is often broken without the tibia, as I shall presently shew, and for reasons that are quite obvious. When the indirect force acts, the fibula must almost always break after the fracture of the tibia has taken place, for the force continues on in the same line, and comes upon the fibula with the additional weight of the body of the person, which now is no longer supported by the tibia, consequently the whole stress tells on the slender fibula, which must give, except under very peculiar circumstances.

The most frequent cause, then, of fracture of the tibia singly, is found to be a force acting directly on the bone itself, such as a blow from any hard body, as a kick from a horse, or a heavy weight falling on the limb so as to come upon the tibia, and not to include the fibula. I once saw a case which well illustrated the action of the direct force on the tibia, where the head of the bone was comminuted, but the fibula escaped unhurt. The case was that of a boy brought to the Middlesex Hospital in the year 1835: he had been run over by a cart, the wheel of which passed so obliquely over the limb, that the head of the tibia only was included by the pressure, the fibula not being injured at all. The outer condyle was also partially split. The direction the fracture of the tibia singly takes, is generally more transverse than oblique; or else comminuted into two or more pieces. For when

the fracture is oblique, the force is more likely to tell upon the fibula afterwards, and so to cause fracture of both bones. The situation of the fracture varies: I think, however, that I have observed that it is more frequently situated in the upper than the lower half of the bone, when the tibia only is broken; and that fractures of the tibia, lower down, are generally accompanied with fractures of the fibula also. These circumstances, then, will account for the tibia being so seldom fractured by itself.

The fracture of the tibia sometimes takes a vertical direction: this, however, is generally found to be when the lower end of the bone is the seat of the injury. The upper end, or head of the tibia, is little liable to be brought under a force that can cause the fracture to take this direction; for the spongy nature of this part of the bone, as well as its strength and situation, render it necessary that a very violent force should act before fracture at all can be produced; and then it extends in many directions, and causes it to be comminuted more or less, according to the degree of force that has been applied.

Fracture of the lower end of the tibia, however, in the vertical direction, is by no means a common accident, without fracture of the fibula also. And this is not to be wondered at, when the nature of the force is considered: for when it takes a vertical direction through the lower end of the bone, the injury is generally caused by the person falling or slipping with the foot so placed that the inner malleolus comes in forcible contact with the astragalus, so that the fracture takes a direction that causes the malleolus to be separated from the rest of the bone; and the consequence of this is, that the stress of the weight of the

body comes afterwards upon the fibula, owing to the position of the foot favoring the force in this situation, in a similar manner to the Pott's fracture, as it is termed; except that the ligament is then only torn—while in the case we are now considering, the tibia as well is the seat of fracture. The position of the foot may very much resemble that of Pott's fracture; for there will be strong eversion or abduction, with separation of the inner edge of the tibia from the astragalus.

The displacement in fracture of the tibia singly, is seldom very great, and often none at all; for, as might be expected when the fibula remains entire, it will serve as a kind of splint, and prevent the portions of bone moving from one another to any great extent. The direction of the fracture also prevents the ends of the bone being displaced: for in the shaft of the bone it is generally more transverse than oblique; and in the extremities of the bone, if the upper, the fracture is generally comminuted; and if the lower, it is either transverse or vertical, in either of which cases there is no disposition for the ends of the bone to slip from their apposition. In some kind of fractures, however, near to the ankle joint, when the injury is caused by a fall, and not by a direct blow, there may be displacement, although the fibula remain entire; for the weight of the body will continue the force onwards after the tibia is broken, and so produce a distortion in the position of the foot and ankle joint, according to the direction in which the force is applied. Thus in a fracture of the lower end of the tibia, about an inch, or an inch and a half above the ankle, that portion of bone connected with the astragalus will move in whatever direction the foot is forced, and so may be twisted upon the shaft of the bone, or pushed backwards or

forwards to a sufficient extent to produce a marked distortion, and to indicate that some unnatural displacement exists in the situation of the injury, although the fibula remains entire; for the length of the fibula, and its lateral mode of articulation, will allow of a certain degree of displacement of the foot, when the tibia is fractured, though not sufficient to destroy completely the contact of the fractured surfaces.

In the vertical fracture through the lower end of the tibia, the indications of the particular kind of injury are very obscure, for the displacement of the fractured portions is so slight, that no deformity in the bone itself is present; nor is there any crepitus, for no motion can be produced to cause the fractured surfaces to move upon one another. In some cases of this fracture, where the inner malleolus is separated, and which is the most frequent direction for the fracture to take, the foot may be violently twisted outwards by the weight of the body telling on the ends of the bone after the fracture is produced, so as to strain the inner side of the joint; the consequence of which will be, that the astragalus presses unequally on the articular face of the tibia, and may push the separated malleolus from its natural position, and cause a prominence at the inner ankle that ought not to exist. This unnatural prominence, however, is a very equivocal symptom; for it is difficult to say, when the foot is strongly abducted or everted, how much of the deformity is owing to the ligaments being strained or ruptured, and so causing the end of the bone to be more prominent than natural; and how much of it is owing to the malleolus itself being driven from the astragalus, owing to the fracture being present. As a general rule, I should say it is next to impossible to

distinguish the vertical fracture, extending upwards through the lower end of the tibia, when it is confined to the lowest inch or inch and a half of the bone. It is an injury, however, that is generally accompanied with fracture of the fibula, for it must be a very violent kind of force to produce it, and one that will be very likely to pass to the fibula afterwards, and cause the strain to come upon the fibula, in a similar manner to the kind of force that produces Pott's fracture.

Fracture of the shaft of the tibia only, often takes a completely transverse direction; and then there is of course no displacement, either angularly or otherwise. In these cases it is generally very difficult to discover clearly the nature of the injury; for as there is no displacement of the portions of bone, and the fibula remaining entire, there are no means of discovering the usual symptoms, namely, the motion and the crepitus. I remember two cases, in particular, where the tibia was broken transversely by itself, in which it was amazingly difficult to ascertain the existence of the fracture, and the precise situation of it. In both cases, the nature of the injury was one likely to produce fracture (a heavy weight having fallen on the leg); and in both there was a small circumscribed tumour opposite the point struck, and inability to bear any weight upon the limb. On examining the part, no prominence could be felt; nor could any motion of the two portions of bone at first be obtained. It was only by grasping firmly the two ends, and then placing the finger opposite the injury, that slight motion could be felt, when the lower portion was moved backwards and forwards on the upper. In both these cases the diagnosis was confirmed as soon as the ecchymosis subsided; for

then a hard ridge of callus could be felt, of a very defined shape, running transversely across the bone, and which remained there for many weeks after.

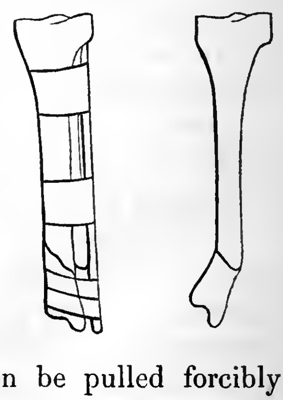
Motion of the fractured portions and the crepitus, when the tibia alone is broken, can be produced with more facility in some cases than in others; for, as already stated, when the fracture is situated in either extremity of the bone, so as to include the joint, no displacement occurs, nor can any motion be produced between the fractured surfaces, nor any crepitus either. When the injury is in the shaft of the bone, the direction of the fracture influences the production of these symptoms; for the more oblique it is, the more easily are the ends of the bone moved upon one another; and then the motion and crepitus become apparent; while in the transverse fracture, as already stated, it often is impossible to get these indications sufficiently marked to decide with certainty on the nature of the injury.

TREATMENT OF FRACTURES OF THE TIBIA.

Fractures of the tibia singly, are to be treated on the same principle as when both bones are the seat of the injury: that is to say, the limb is to be placed in the position which most relaxes the muscles that are inclined to produce spasm, and which supports the bone throughout its length, so as to keep the fractured ends in proper contact. As a general rule, it will be found to be much easier to treat fractures of this bone singly, than when both the bones are broken; for, in the former case, there is no great retraction to overcome, owing to the fibula remaining entire.

In the majority of cases of fracture of the tibia singly, the straight position of the limb, by placing it

in the junks, or by employing lath splints, and placing it on its outer side, will be found quite sufficient to keep the ends of the bone in their proper apposition. There are cases however that present more difficulty in their treatment; for when the fracture is very oblique (although the fibula be not broken), a projection may take place of one or both ends of the bone, and produce a prominence and deformity that it is often difficult to overcome: the consequence of which is, that angular displacement occurs, and often to a degree to render the limb very weak, and to be a long time recovering sufficient firmness to bear the weight of the body upon it. If the fracture take a direction laterally—by extending downwards and inwards or outwards at the same time, an additional degree of pressure is required during the treatment on the outer or inner side of the limb, according to the line of displacement. And this is to be gained by employing a splint in a similar manner to that recommended for the treatment of fractures of the fibula, as employed by Dupuytren. Thus if the fracture take such a direction, that the lower portion of bone has a disposition to turn inwards or outwards, the side splint, as represented in the wood-cut, must be laid along the edge of the limb, and fixed firmly to the upper part, with a compress placed beneath it. The



lower portion of bone must then be pulled forcibly towards the splint, and be kept there by a bandage passed round it many times. I have seen fractures of the tibia brought into proper position by this means,

when other kinds have failed. The principle of its application is precisely the same as the splint for fractures of the fibula.

It is often practicable to employ the lath splints immediately after the injury, when the tibia only is broken; for little or no swelling takes place in many cases, and thus pressure can be borne from a very early period. In the fracture through the lower extremity of the bone, and where it extends transversely across, great difficulty often exists in reducing the displacement; for the fractured surfaces are so broad and rough, and so locked against one another, that it is not unfrequently impossible to bring the lower portion of bone back again to its natural position.

In the vertical fracture through the lower end of the tibia, no mechanical apparatus is required, without the fibula be fractured as well, for no displacement takes place: and, if there were any, no violence could be applied to reduce it, owing to the injury being so near to the joint, and to the pain and swelling preventing any pressure being made upon the part. In these cases, leeches, cold lotions or ice must be frequently applied; and must be changed for poultices or fomentations, according to the kind of inflammation, and as the patient may find relief from the application of the one more than the other. Immediately after the injury cold will be the best application, and ice is preferable to the common cold lotion, for it has more power of checking the action of the vessels, and diminishes the vascularity of the part generally, and consequently keeps back the inflammation. If, however, the joint should become much swollen or inflamed, the cold must be discontinued, and leeches and fomentations substituted in its stead. The easiest

position for the limb is on its outer side; for, as the fibula is not broken, pressure can be borne without doing injury to the soft parts around. The limb may be steadied by laying it on Sharp's splint, with a few turns of bandage passed lightly round the upper part of the leg and the foot.

In the fracture of the upper end or head of the tibia, it will be best to place the limb on the inclined plane; for then the ham-string muscles will be relaxed, at the same time that the posterior part of the bone will be supported, and retraction prevented. It is seldom however that simple fracture of the head of the bone occurs; and the compound one is generally of so serious a nature, that it more frequently becomes a question as to the propriety of amputating the limb.

The period during which it will be necessary to confine the patient to his bed, varies as much in fractures of the fibula as it does in fracture of both bones; for if the fracture be very oblique, it will require a longer time for the callus to gain sufficient strength to support the weight of the body, than if the fracture were transverse; for then the ends of the bone themselves would support one another, and require less pressure to be made upon the callus. When the fracture is into the joint, of course a longer time is required, owing to the inflammation that comes on being greater, and requiring a longer time to subside; motion must not be given to the limb until all the inflammation has subsided, and then should only be very cautiously used at first.

FRACTURES OF THE FIBULA.

Fractures of the fibula often occur without the force extending on to the tibia; for a force may tell upon so

long and thin a bone as the fibula, and still not have power enough to fracture the tibia. A very slight direct force may fracture the fibula, when applied to the centre of the bone, while it requires a very powerful one to break through the thick tibia.

Although the fibula is so slender and long a bone, its fracture does not occur so often as might be expected, when the bone itself is considered in its unconnected state from the tibia. The fibula is joined superiorly to the head of the tibia and to the condyles of the femur, by means of strong bands of ligament, while inferiorly it is connected to the lower end of the tibia and to the foot, by strong ligaments also. For these reasons, it is scarcely ever found that dislocation of this bone from the tibia takes place; for although these joints themselves are weak, when compared with others, they are still strong enough to resist any force that could tell upon them, without fracturing the fibula; for generally it will be found that this bone yields and breaks, and then of course the further extension of the force is checked, and does not reach the joint.

The fibula is more frequently fractured by the indirect than by the direct force; for the office of this bone is merely to strengthen the ankle joint, and give attachment to the muscles that act upon the foot; it is not meant to take any part in supporting the weight of the body. Any particular position of the foot then, that takes some of this weight off the tibia, and throws it on to the fibula, will place the bone under circumstances very likely to cause its fracture. We have then to consider the fracture of the bone under two heads, namely, that kind produced by the direct force, and that produced by the indirect force.

When a person falls with the foot turned outwards, the weight of the body is to a certain extent taken off the tibia and thrown upon the fibula; for the astragalus is pushed forcibly against the fibula, at the same time that the weight of the body above pushes the fibula forcibly down upon the astragalus. The consequence of which is, that the bone first of all bends inwards towards the tibia, and then snaps, not being able to support the additional weight that is put upon it. But the fibula cannot be so pressed against the astragalus, without some alteration taking place on the inner side of the ankle joint, to allow of this bone being carried underneath the end of the fibula. In other words the astragalus must be separated from the inner malleolus, and this cannot be done without straining or rupturing the internal lateral or deltoid ligament that braces the malleolus down, and keeps it in contact with the astragalus. Now this rupture of the inner lateral ligament, and fracture of the fibula, constitutes that peculiar fracture, called "Pott's fracture,"—Mr. Pott having particularly described it. His words are, "I have already said, and it will obviously appear to every one who examines it, that the support of the body, and the due and proper use and execution of the office of the ankle, depend almost entirely on the perpendicular bearing of the tibia upon the astragalus, and on its firm connection with the fibula. If either of these be perverted or prevented, so that the former bone is forced from its just and perpendicular position on the astragalus; or if it be separated by violence from its connection with the latter, the joint of the ankle will suffer a partial dislocation internally; which partial dislocation cannot happen, without not only a considerable extension or

perhaps laceration of the bursal ligament of the joint, which is lax and weak, but a laceration of those strong tendinous bands, which connect the lower end of the tibia with the astragalus and os calcis, and which constitute in a great measure the ligamentous strength of the joint of the ankle.

"This is the case, when by leaping or jumping the fibula breaks in the weak part already mentioned, that is within two or three inches of its lower extremity."

Pott's fracture may be defined then, as fracture of the fibula about three inches above its lower end, accompanied by partial dislocation of the tibia from the astragalus, owing to the rupture of the internal lateral ligament. I do not, however, think that it is always necessary for the fibula to be broken by this kind of force, that the internal lateral or deltoid ligament should be torn through; for some people have this ligament naturally so lax, that great eversion of the foot may take place, and be quite sufficient to throw the astragalus against the lower end of the fibula, so as to bring the weight of the body upon it; when if any violence be applied, such as jumping or suddenly slipping, the bone will break, without the necessity of tearing through any of the ligamentous fibres, which naturally ought to be short enough to brace the end of the tibia firmly down upon the astragalus, and to keep it in its place.

Fracture of the fibula may be accompanied with two other kinds of dislocation of the tibia; the one is, when the end of the bone is displaced forwards on the tarsal bones; the other when it is displaced completely inwards, lying to the inside of the astragalus, the contact of the articulating surfaces between it and the lower end of the tibia being lost. This latter kind of

injury may be produced by the same force that causes Pott's fracture, only being of a much more violent kind, the direction which it takes being the same. In both these cases, however, the dislocation is the most important part of the injury, the fracture comparatively requiring little attention, and when the tibia is reduced, the fracture is to be treated in the same manner as when the dislocation is absent; the state of the joint, however, prevents any mechanical apparatus being applied till some time after the injury.

The point at which the fibula yields when fractured by the indirect force, depends upon the direction and the degree in which it is applied; for if the limb be placed very obliquely when the patient falls, and the force very powerful or sudden, the bone will break much nearer to the joint, than when the limb is placed less obliquely, and the force less sudden; for as the indirect force fractures the fibula by the weight telling perpendicularly in a line drawn through this bone instead of the tibia, the more obliquely it is placed, the nearer the perpendicular line will come to the ankle joint, and so will cause the fracture to be nearer as the force tells through this line.

It is not necessary when the fibula is fractured by the indirect force, that the internal lateral or deltoid ligament should always be lacerated; for there are many cases, as already stated, when this ligament is lax, and so will not be put upon the stretch sufficiently to rupture it; while there are other cases where the ligament does not yield at all, and yet the fibula may be fractured. As a general rule, however, when the bone is broken by this indirect force, the internal ligament always suffers more or less.

The direct force acts upon the fibula in any part of

its length to which it happens to be applied ; which is easy to understand, for so long and slender a bone, being supported only at its two extremities, will be liable to yield when a weight or blow comes upon it in the intermediate portion, and will then break opposite the point struck. Various kinds of forces may act upon the bone in this manner : thus a smart blow from any hard substance will cause its fracture, though the patient be standing upright ; it more frequently happens, however, that the leg is lying on the ground, horizontally, and then is brought under the influence of some heavy force, as a wheel passing over it, or a weight falling upon it.

Pott's fracture need not necessarily be caused by the indirect force, for it may happen in the following manner :—Suppose a person, with the leg obliquely placed, to receive a violent blow on its outer side, telling upon the fibula first ;—the force may fracture this bone and then come upon the tibia, which it may not have sufficient power to break, but, combined with the weight of the body, will throw all the stress on the inner side of the ankle joint, and strain or rupture the ligament. In these cases, however, the fibula is generally broken much higher up than when the indirect force acts.

The symptoms of fracture of the fibula singly, are not sufficiently prominent to create any great degree of external deformity ; for the tibia remaining entire, keeps the foot in its place, in the majority of cases, except where the ligament is torn through to any great extent.

Fracture of the fibula, when unaccompanied with rupture of the internal ligament of the ankle, often presents no external sign by which the nature of the

injury can be ascertained; for the foot is not displaced, nor is the apposition of the fractured ends of the bones disturbed; the only symptoms diagnostic of the injury are gained by examining the limb with the hand. The foot must be grasped by placing the sole of the foot in the palm of the hand, while the fingers of the other hand press forcibly opposite the point of bone injured; or by making forcible abduction of the foot, while pressure is at the same time made with the fingers on the ends of the bone, motion and crepitus can be got. This forcible abduction of the foot is only of use when the fracture is near to the ankle. When it is situated towards the middle of the bone, or higher up, simple pressure with the thumbs on each portion of bone is sufficient to cause motion and a crepitus between the fractured surfaces.

In Pott's fracture, the foot is frequently displaced outwards in a marked degree, owing to the rupture of the internal ligament, and the forcible separation of the astragalus from the tibia. The ends of the fibula are also displaced inwards, often being driven quite in contact with the tibia. They are never displaced outwards, for an obvious reason, namely, the interosseous ligament, which of course prevents it in this direction. In addition, then, to the motion and crepitus in Pott's fracture, there is eversion and abduction of the foot, with a depression opposite the fracture of the fibula, which gives the appearance of the foot being twisted outwards, and causes the patient to walk more upon the inner than the outer edge of it; and to bear all the weight and strain upon the internal ligament. The

annexed wood-cut illustrates the position of the foot, and shews the seat of the fracture in the fibula, and the separation of the tibia from the astragalus. The extent of the deformity varies, being more in some cases than in others, and is dependant on the degree of violence applied to produce the fracture.

When the internal ligament of the joint is strained or ruptured, swelling comes on, often to a very great extent; which may be sufficient, if the patient be not seen before it arises, to obscure the nature of the injury altogether; for the shape of the deformity will be altered, and the fracture of the fibula not be easily discovered. In these cases, no opinion can be given until the swelling have subsided, which is generally a long time after the first receipt of the injury.

TREATMENT OF FRACTURE OF THE FIBULA.

Fractures of the fibula, either with or without injury to the internal ligament of the joint, admit of being treated by position only, in the majority of cases; for the displacement is seldom much, and often none at all.

The limb may be laid on a firm pillow, and sometimes the Sharp's splint may be placed underneath the leg, when firmer support is required. The weight of the limb should be made to tell chiefly at the foot and outer ankle, and very little at the point of the fracture; for when the nature of the injury is considered, and the disposition of the foot to turn outwards, the more the pressure tends to throw the foot inwards (which will be the case when it is raised higher and is more supported than the rest of the leg), the more the deformity of the ankle will be overcome, and the ends of

the fibula will also be drawn from the state of inversion towards the tibia. Attention must also be paid to the position of the toes, taking care to raise them to a higher level than the heel, so as to prevent the eversion of the foot. The limb being placed on its outer side, not only offers the easiest and best support for this kind of injury, but it also offers an additional advantage, by relieving the inner ankle from all pressure, and leaving it exposed for the application of local remedies. Of course in those cases of the fractured fibula, which are accompanied with injury of the inner part of the joint, attention must be paid to the joint as much as the fracture, and it often becomes the most serious part of the injury. Leeches, fomentations, or cold lotions, must be applied to subdue the inflammation, and be continued as long as the state of the part requires their use. Care must be taken that the cushion on which the outer surface of the leg rests, is even and elastic: it should be made of flannel or wadding, and not feathers,—for the reasons given when treating of fractures of the thigh.

In the compound fracture of the fibula, it may be necessary to place the limb on its posterior surface, to remove the pressure from the wound. The junks may then be employed, taking care to fix the foot more towards inversion than eversion; which can be done by passing a few turns of bandage round it, and pinning it to the side of the junks.

Very many cases of fracture of the fibula, if not the majority of them, get well by position simply, taking the above precautions with regard to the support of the foot and outer ankle. There are some cases, however, where the force has been very violent, in which the ends of the fibula are driven inwards in contact with

the tibia; and the joint is then strongly everted, and will remain so if the ends of the bone be not reduced to their proper position; the consequence of which will be, that a permanent deformity will exist, and the patient will lose the firm support on the ankle and arch of the foot, owing to the pressure telling more upon the inner ankle than the rest of the joint.

In these cases it becomes necessary to apply some mechanical force that will act upon the foot, and draw it forcibly inwards, and at the same time draw the lower portion of bone from its contact with the tibia; and this is best done by applying a strong splint along the inner side of the leg, long enough to extend some way below the inner ankle, to which the foot is to be bound. This mode of treating fractures of the fibula was first introduced by Dupuytren, and is decidedly beneficial in these cases. I shall give his own description of it:—"It consists of a cushion, a splint, and two bandages. The cushion, made of cloth, and filled two-thirds with chaff, should be two feet and a half in length, by four or five inches in width, and three or four thick. The splint, from eighteen to twenty inches in length, two inches and a half wide, and three or four lines thick, should be made of firm and slightly flexible wood. Lastly, the bandage should be four or five yards in length. The cushion, folded upon itself in the form of a wedge, is applied to the inner side of the fractured limb, and laid upon the tibia, its base directed downwards, being applied upon the internal malleolus, not passing below it: its apex being above and upon the internal condyle of the femur. The splint applied along this cushion should pass below it, from four to six inches, and extend below the inner edge of the foot for three or four

inches. These first pieces of the apparatus are fixed to the upper part of the leg, by a few turns of bandage directed from above downwards; in this state the splint, prolonged like a kind of lever below the base of the cushion, leaves between it and the foot a space equal to the thickness of the cushion, that is to say, from three to four inches. This extremity of the splint will serve as a "point d'appui," to bring the foot from without inwards. For this purpose the end of a second bandage is fixed to it, and then directed successively from the splint over the upper surface of the foot, upon its outer side, under the sole of the foot, upon the splint; then from this upon the instep and under the heel, to return again to the splint, and to be continued in the same manner until all the bandage is used; thus embracing in the same circles, which can be tightened at pleasure, the splint and the instep, and the splint and the heel alternately. The foot is brought into such a state of adduction that its external edge becomes superior, the sole of the foot directed inwards, and its internal edge upwards."* The drawing represents the splint.

The principle on which the above splint acts is easily understood; for the cushion serves as the fulcrum, while the splint as the lever, and the bandage as the force applied; great power is given by this means of drawing the foot forcibly inwards, and with it the lower end of the fibula; so that it at once remedies the two great evils that are met with in Pott's fracture, or in simple fracture of the fibula; namely, the separation of the

* Leçons Orales, tom. Ire. p. 226.

astragalus from the tibia, and the locking of the ends of the fibula inwards against the tibia. It is certainly the best treatment for these cases, and is very simple and easy in its application. I am not certain, however, that it will always fulfil the object for which it is employed; for I believe that there are some cases, where the ends of the fibula are so jammed against the tibia, and locked together by the particular direction of the fracture, that they cannot be acted upon by the force telling upon the foot, but that all the splint then does is to pull upon the joint and ligaments. In this respect the fracture of the fibula in many cases resembles fracture of the lower end of the radius, where the same principle is exercised to reduce the fractured portions; but which I believe often tells upon the joint only, and leaves the ends of the bone without acting upon them at all. Dupuytren's splint, however, should always be tried, as it offers the best chance of success.

The period of confinement in fractures of the fibula, as a general rule, need not be so long as when both bones are injured. In the simple fracture, three weeks will be sufficient, where there has been no strain upon the ankle joint. In those cases, however, where the joint has been violently injured, six weeks or two months are often necessary, and sometimes a longer period, before the joint can recover sufficiently to bear the weight of the body upon it, or admit of flexion and extension. Circumstances must guide the surgeon, as to the condition the limb may be in to allow of the patient getting up. If there be much disposition to eversion of the foot, the patient's shoe should be made with the sole thicker on the inner than outer edge, so as to make him walk more on the outer than inner side of

the foot, and so throw it into a state of inversion; or, in other words, to press the astragalus upwards against the inner malleolus: this may tend to overcome the deformity, and allow of the internal ligament becoming shorter and stronger than it otherwise would be.

FRACTURE OF THE BONES OF THE FOOT.

Fractures of the bones of the foot resemble in many respects those of the hand, for the general shape and structure of the different bones are similar; which places them under circumstances that render it necessary for the same kind of force to act upon them before their fracture can be produced; and that the same kind of treatment should be adopted to effect their union. The bones of the tarsus are of the same cuboid shape (though larger), and of the same spongy structure as the bones of the carpus. These latter bones are never broken but by the direct force, for their shape and mode of articulation, does not place them under the influence of the indirect. And the same thing occurs with regard to the bones of the tarsus; for, although they are larger, their general shape and mode of articulation are the same. An exception, however, may be made of the os calcis, which may be fractured by the action of the muscles of the calf of the leg. The other bones of the tarsus must be acted on by the direct force, before their fracture can be produced. The position and shape of the astragalus and os calcis, place them under circumstances that differ from the other bones of the tarsus, and destroy to a certain extent the analogy which these bones bear to the carpus.

When speaking of fractures of the bones of the carpus, I mentioned that it is scarcely possible for their fracture to occur without injury being done to

the soft parts, and that generally this was of a very serious nature. The same evil exists in fractures of the bones of the tarsus, with the exception of the astragalus and os calcis. The cuboid, os naviculare, and the three cuneiforme bones are so placed, that their fracture generally occurs by a heavy weight of some kind falling upon the foot, or by a wheel passing over it; there being a resistance on the opposite side, such as the ground, or any other hard substance; under these circumstances the soft parts on the instep and sole of the foot must suffer, according to the power of the force applied, the fracture is also on this account often rendered compound. Fracture of the os calcis and astragalus, however, may occur without there being this marked and extensive injury to the soft parts; for a different kind of force is capable of acting upon them, and so producing different effects. The os calcis presents a projection posteriorly, for the attachment of the soleus and gastrocnemius muscles, which exposes it to powerful action; and brings the bone in some respects under similar circumstances to the patella, when it is acted upon by the powerful extensors of the leg. This projection posteriorly also exposes the bone to external violence; for it is large enough to enable a force of any kind to come in contact with it, such as a heavy stone falling upon it, or a wheel passing over it. This projection also gives a force a lever power, as when a person jumps from a height, and falls more upon the os calcis than the rest of the foot. Fracture of this bone is a very rare kind of accident, whether it be produced by the action of the muscles, or by a blow upon the bone. The action of the muscles differs in one respect from those that produce the fracture of the patella; namely, that

while the extensor muscles of the knee generally fracture the patella when in violent action, the muscles of the calf of the leg more frequently rupture the tendo achillis, than break the os calcis. The reason of this is, that the tendon in the latter case is so much longer than in the former, at the same time that the bone is thicker and less brittle, and is not placed under the same mechanical advantages as the patella is, when it is broken by muscular violence.

Two things are necessary in order to produce fracture of the os calcis by the action of the muscles; the first is, that the muscles must be very powerful; and the second is, that the person should be heavy enough to offer a resistance sufficient to their action, when the violent and sudden effort is made to raise the body on the toes, which action must take place before the fracture can be produced. A light person with weak muscles, could never produce fracture of this bone in this manner, from the absence of the above circumstances; all that would take place then, however violently the muscles acted, would be to raise the os calcis from the ground, and the body with it.

The astragalus may be broken singly, without any of the other tarsal bones being injured, by the tibia being forcibly thrust against it; as when a person jumps from a height, and comes to the ground with the tibia placed vertically on the astragalus, the shock may then be sufficient to split the bone. I once saw a case of this kind, produced in the above manner, there were no symptoms to indicate the nature of the injury, for the fractured portions were not displaced, and there was only swelling of the joint generally. The patient was treated for a severe sprain, there being no reason to suspect a fracture; the inflamma-

tion of the joint, however, was so great, and the man's constitution became so much affected, that the man died on the twelfth day. The case was considered peculiar, from the severity of the symptoms; on opening the joint, however, after death, the astragalus was found to be split in two or three directions, which fully accounted for the constitutional disturbance, and for the other serious effects produced by it.

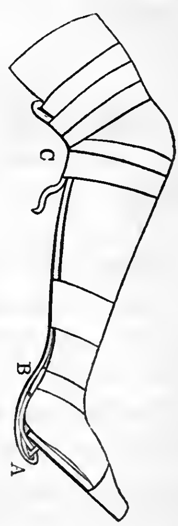
The astragalus may of course be broken by external violence as well; but in these cases the bone is seldom if ever broken by itself, for the kind of force must be such as to include some of the other bones as well, and render the injury one of so serious a nature, as to give very little chance of recovery of the bones, or for the life of the patient, if the foot be allowed to remain on.

When fracture of the os calcis occurs, the symptoms will be motion of the fractured portions, with a crepitus; the displacement cannot be very great, for the strong plantar fascia, which is very thick at its insertion into the under part of it, will prevent any great retraction without it be torn through, and which is not very likely from the strength of its fibres. It might be expected from the powerful muscles that are inserted into the os calcis, that the fractured portions of bone would be drawn considerably upwards by their action, but this is not the case, and owing to the above ligament. There is great pain accompanying this kind of injury, with inability to bear any weight on the limb, and great swelling also comes on shortly afterwards. The two diagnostic symptoms, are motion and the crepitus produced by the fractured portions; the displacement must not be depended on without it be very marked, for it is often not to that extent to

make it a prominent symptom, and it is less where much swelling is present.

Fracture of the os calcis is the only one of the tarsal bones that admits of any mechanical treatment; for all the others are so small, and of such a shape, that no pressure can be made upon them.

As soon as the swelling and inflammation have subsided, the part should be supported by strips of adhesive plaster spread on leather, and made to pass from the back of the heel to the side of the foot; some of them crossing over the instep, and others under the sole of the foot. A compress may be placed just above the os calcis, and firmly bandaged in this position, to guard against retraction of the portion of bone upwards. The ankle joint should be extended to the utmost, and the knee joint flexed at right angles with the thigh, to relax the muscles of the calf of the leg.



The following kind of apparatus may be employed, where there is much displacement of the fractured portions of bone. It consists of a foot-board with a slipper end to it, to fit the toes into. The foot-board itself should not be long enough to reach quite the end of the heel, but to stop at about an inch from it; and have a small ring placed underneath it, to allow of a bandage being passed through it, as represented at A in the wood-cut. The foot-board being adjusted, a pad, B, is to be placed on the back of the heel, just above the os calcis, and pressed firmly in this situation by a bandage or plaster, so as to make it sink sufficiently to have a hold upon

the bone. To this pad a long strap is attached, which pulls the pad downwards towards the foot-board, being passed through the ring, A; at the same time it presses the fractured surfaces together, owing to the position of the ring causing the strap to tell against the back of the heel before it can pull through it. The pad being well fixed then, the strap is pulled downwards through the ring, A, and then carried upwards along the calf of the leg, and confined against the surface of the limb, by means of a bandage passed circularly round it. The back strap may extend some little way above the knee, and then be turned down again upon itself, and included in the folds of the circular bandage, as represented at C. The portion of bone will be firmly fixed by this means, and any degree of force requisite may be applied, and be retained, if the points, A, B, C, are well attended to. The advantage of this mode of applying the strap is, that at the same time that it fixes the fractured portions of bone, it also fixes the ankle joint in a state of extension, and the knee joint in a state of flexion, owing to the peculiar manner in which the purchase is gained for the strap to act upon.

Fracture of the os calcis is an injury that is often attended with very serious consequences, owing to the violence of the shock that generally produces it: serious inflammation may come on after it, and cause great constitutional disturbance, such as to endanger the life of the patient.

In fracture of the other bones of the tarsus, nothing more can be done than was recommended when treating of fracture of the carpus. If it be deemed advisable to try and save the foot, all that can be done is to apply active local remedies, such as leeches frequently, and employing general blood-letting, if ne-

cessary; with the application of poultices and fomentations. No mechanical means are requisite, for there is no displacement of the portions of bone. The local symptoms often do not remain confined to the foot, but spread up the leg, and cause the inflammation to run so high, that suppuration takes place in the cellular tissue beneath the skin, causing abscesses to form in different parts of the limb. With this extent of inflammation the constitution generally sympathizes, and requires active treatment, as well as the local injury.

Fracture of the tarsal bones, is generally followed by sloughing of the soft parts around; for the nature of the force that causes the injury is such as to bruise and crush the skin and parts beneath, at the same time that it produces the fracture; for there must be a resisting force on the opposite side of the foot, which causes more mischief to be done than where the indirect force acts upon the part. The metatarsal bones are not broken so often as the metacarpal, for they are not so much exposed to injury: they are not either broken by the indirect force, which the latter bones often are. It requires a force to be directly applied, to break the bones of the metatarsus; such as a heavy weight falling on the part, or a wheel passing over it. From this circumstance, it is found that the fracture is more frequently compound than simple; whereas, with the metacarpus it is just the reverse. The metatarsal bones are seldom broken without the bones of the tarsus being included in the injury, owing to the kind of force that causes the fracture—though, of course, if the force include the metatarsus alone, it will only fracture these bones.

The treatment of these cases of fracture of the meta-

tarsus can only be general; for no mechanical means are required, nor could they be employed if they were, for the inflammation that arises would prevent pressure being made upon the part. The injury is to be treated according to the degree of local inflammation present, by applying leeches, poultices, and fomentations.

The phalanges of the toes are much less frequently fractured than those of the fingers; and their fracture is generally compound, owing to the nature of the force that produces the injury.

The treatment of fracture of the toes is very simple: all that can be done, is to place a splint along the sole of the foot, with a compress of lint, and to confine it with a few turns of bandage. If the great toe only be fractured, this toe alone need be confined by placing a splint along its under surface. If the soft parts be much bruised, the patient should keep his bed for some days, and should not be allowed to walk about till all the pain has subsided. It is not uncommon to find great irritation arise after fracture of the great toe; for the absorbents up the inside of the leg soon take on inflammation, which often extends up to the groin, causing abscess to form in different parts of the limb. Sometimes the inflammation spreads to the limb generally, and produces great constitutional disturbance. These cases are to be treated on general principles, the fracture not requiring much consideration. Care should be taken that the matter does not collect round the ends of the bone, or under the fascia; and free openings must be made to let it out—by doing which, a great deal of relief will be given to the patient, and the inflammation be prevented spreading.

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